

The Chemical Age

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Notes and Comments

The British Association

THE British Association for the Advancement of Science opened its annual meeting at Aberdeen on Wednesday, and in other pages of this issue we give extracts from the presidential address of Sir James Jeans and the address which Professor Lowry gave as president of the Chemistry Section. The Lord Provost of Aberdeen and the Principal of the Aberdeen University welcomed the Association at the inaugural general meeting on Wednesday evening, and Sir James Jeans read a message which had been sent to the King on behalf of the members, and his Majesty's reply. The message to the King, signed by the president, was as follows: "We, the members of the British Association for the Advancement of Science assembled in the City of Aberdeen in annual session, desire humbly to recall to your Majesty that it was in this city that his Royal Highness the Prince Consort assumed the presidency of the Association in the year 1859. From the presidential chair he conveyed to the assembled members of the Association a gracious message from her Majesty Queen Victoria, and delivered an address which disclosed his own profound interest in the advancement of science. The many marks of Royal favour which have been extended to our Association on subsequent occasions have provided further signal encouragement to us in our pursuit of the aims defined by his Royal Highness, and on all these counts we now desire to express to your Majesty our humble gratitude." The King's reply, sent through Sir Clive Wigram, was as follows: "I am commanded by the King to thank the members of the British Association for the Advancement of Science for the loyal message which they have addressed to his Majesty, their Patron, from the inaugural general meeting in the ancient City of Aberdeen. His Majesty appreciates their kind remembrance of the occasion when the Prince Consort, as President of the Association, delivered a message from Queen Victoria to the members assembled in this city three-quarters of a century ago. The King desires me to assure the members of his unabated interest in their meetings, and his confidence that their investigations into the manifold problems confronting present-day scientists will continue to be productive of results which will benefit mankind." After Sir James Jeans had delivered his presidential address Mr. Elliot, the Minister of Agriculture, proposed a vote of thanks, which was carried with great applause.

The council announced that it had nominated Professor W. W. Watts, F.R.S., for recommendation

to the General Committee at its meeting next Tuesday for election as president of the Association at the Norwich meeting next year. Professor Watts is a distinguished geologist, Emeritus Professor at the Imperial College of Science and Technology, South Kensington, and an Honorary Fellow of Sidney Sussex College, Cambridge. In his presidential address Sir James Jeans discussed not only the new world-picture of modern physics, on which there is no higher living authority, but also a philosophical problem than which there is none older or less likely to be solved.

Chemical Health Hazards

A PERUSAL of the remarkable paper presented by Dr. J. Grant Cunningham before the Ottawa Section of the Society of Chemical Industry causes one to wonder how it is possible for human beings to work in chemical factories and yet die of old age in their beds! It is not as if the dangers from chemicals were physical dangers capable of being seen and met as men meet death daily on the roads, or in times of madness on the field of battle. Some poisons there are that fell like a blow from a fist—the victim passes out without knowing what has hit him. Probably those are in point of fact the less dangerous poisons. When a man falls unconscious clearly something is the matter with him and he must be treated as soon as possible. It is the insidious poisons such as lead that probably do most damage in the long run; for years a man may take no apparent harm but all the while the poison is doing its work and from five to twenty years after exposure the victim may die. Most cases of lead poisoning occur from storage battery manufacture, from reclaiming scrap metal and from spray-painting. Lead is usually inhaled as dust and as little as five milligrams of lead per 10 cubic metres of air will cause poisoning in a few months—the dose required is very little. The poison, moreover, is cumulative because the rate of excretion is less than the rate of inhalation. Moreover, even if no symptoms have been noticed the poison may remain in the body, and may only be revealed in its virulent form. When something (*e.g.*, influenza, or too much alcohol) upsets the delicate balance, lead is released from the bones, and even twenty years after the termination of exposure, the subject dies.

Inventions of the Devil

DR. CUNNINGHAM described the action of many of the chemical poisons which may be met with in industry: Benzene, aniline, the phenylamines, the azo-

group of dyestuffs, paranitraniline, paratoluidine, dinitrophenol (to which curiously women are less susceptible than men), cyanamide, the chlorinated hydrocarbons, anthracene, hydrogen sulphide, nitrous fumes, arsenuretted hydrogen, cyanides, silica dust, antimony sulphide, and so forth. Many substances known to have toxic properties clearly could not be mentioned in the time available.

It is highly necessary that those in charge of chemical plants should possess as much knowledge as possible about the poisonous properties of the substances handled or likely to be evolved in the processes they control. Contributions such as that of Dr. Cunningham have a high value in enriching with specific information the literature that is readily available to chemists. There is no danger more insidious than that of chemical poisoning. Some poisons react upon the human body almost insensibly and the victim frequently collapses without being conscious that he has been in any danger. Even qualified chemists, although quite cognisant of the danger do not take the precautions they should. Familiarity with chemicals—as with other forms of lethal weapon—breeds contempt. The human being is by nature optimistic. What is happening every day to our fellows can never happen to us, we think—until too late. The record of safety in the chemical industry is a high one. With the continual development of new substances and new processes, it becomes even more difficult to maintain this high standard particularly when, without experience, as certain happenings recorded in our columns during the last twelve months have shown. Those whose duty it is to design a chemical plant must have one eye on technical efficiency, and the other on human safety.

Gas Cylinder Explosions

WE had the temerity in our issue of March 24, 1934, to mention a new type of gas cylinder that has recently attracted some notice and at the same time to recommend that those who supply compressed gases should consider the possibility of using these cylinders in order to make the already reasonably safe operation of handling compressed gases yet safer. By doing this we aroused the ire of our contemporary "Industrial Gases," and received the rebuke of the Editor. We replied to this rebuke on June 2, making our point so clear that we did not anticipate that it could be disputed. However, the Editor of "Industrial Gases" is not content to allow the matter to rest there and again informs us in the current issue of his paper that all is well in the compressed gas field and that suggestions from outsiders—even if those outsiders represent the customers—are neither welcomed nor desired. Our contemporary having (wrongly) assumed that we based our suggestion on the newspaper reports of gas cylinder explosions ("which our own investigations had shown to be without foundation," he adds) goes on to mention a number of reasons why gas cylinders explode. One is when gases (hydrogen and oxygen) are inadvertently mixed in a cylinder; "at one time," he says, "this was a common cause of violent explosions," and "is only checked to-day by efficient safety measures which the manufacturers have gradually introduced." Again we read that even to-day "it is the abnormal and unknown internal gas pressures, due to heating and other mysterious (*sic*) conditions arising within the

cylinder that are the most frequent causes of explosion." Our critic, whilst vigorously protesting that certain recently reported explosions were due to gas cylinders, agrees therefore by inference that gas cylinder explosions do occur. Improvement is therefore still possible.

Our only object in suggesting that the special cylinders should be considered was to assist in making the use of compressed gases a little nearer to 100 per cent. safe. The loss of even one life per year—we do not know what the mortality from this cause is—is worth while preventing. The Editor of "Industrial Gases" mistakes altogether the reason which prompted us in bringing forward the new cylinders. It was not to achieve lightness or any of the other advantages he mentions in his endeavour to destroy our case; we only instanced the use of cylinders for compressed coal gas driven vehicles as evidence that these cylinders had apparently passed the experimental stage. Our point is not that these cylinders will withstand internal pressure. Briefly it is that when they burst they do not burst into fragments like a shell, but split longitudinally and therefore with far less likelihood of danger to those in the vicinity. It may be that experiment will show that if charged with high explosive gases, or if heated internally so that the pressure rises to bursting point, even these new cylinders would fly into fragments; if that be so, there is clearly no advantage in using them for ordinary compressed gas conveyance, and we shall be the first to say so. All the bursting experiments we have seen on these cylinders have concluded with a split, not a burst.

On Common Ground

WE do not attach any importance to the Home Office regulation that the cylinder used for coal gas vehicles shall be fitted with bursting discs or fusible plugs. The Home Office must naturally take all precautions against damage to people in the public streets when motor accidents may involve entirely untried risks. Finally, we would assure our contemporary that we are not critical of the manufacturers of compressed gases except in-so-far as they resent well-intentioned suggestions—though we believe the resentment is only in the mind of the Editor of "Industrial Gases"—we are quite prepared to believe that existing gas cylinders are carefully tested and that the results of these tests compel "heavy sacrifices which gas compressors make year by year through scrapping and replacing cylinders." We have no doubt that, being business men, gas compressors add the cost mentioned to the cost of the gas; it is difficult to see how the business could be run at a profit if it were not so.

We do not propose to cloud the issue by referring in detail to all the minor points raised by the Editor of "Industrial Gases" in his attempt to discredit our suggestion. We join heartily with him when he says that "however we may disagree as to methods we are confident that on the question of safety, we are entirely at one." Our contemporary has told us why gas cylinders explode; we will agree that his expert knowledge entitles him to credence. If under these conditions the new cylinders burst with fragmentation our case falls to the ground. If not, he must confess that in the interests of safety our suggestion is worthy of being followed up.

The British Association for the Advancement of Science

THE meeting of the British Association for the Advancement of Science this year takes place for the third time in Aberdeen, from September 5—12; it was last held there all but fifty years ago, in 1885. The intervening period may well be ranked as the most momentous in history, owing to the advance in natural knowledge and the use that has been made of scientific method in manufactures and commerce. Chemistry was but a dim Phoenix and electricity only just being tamed to the service of the engineer, in the early eighties; fuel oil was not yet in systematic use; the internal combustion engine had still to be made a popular toy and the gentle art developed of killing with it on the roads; flying and wireless were unthought of by the public. There can be no question that the great war vastly accelerated invention: not only was this spurred on by necessity but experiments became possible regardless of cost; the lesson was thereby learnt that the art of experimental inquiry was not the mere practice of genius but that progress could be worked for and promoted by patient, systematic observation, to determined ends, both in laboratory and factory. Now, so-called research is becoming a mere civil service complaint, a communal mosaic disease: there is danger that it may even ripen into a social cancer. Before the war a conservative nation, not easily stirred to use imagination in manufacturing enterprise, our industrial community has now been led to see that success in business involves more than mere mother wit. After a long period of prevarication, during which we allowed our teutonic rivals to get thirty to forty years ahead of us, English industry since the war has advisedly entered into a Chemical Age; the discovery has been made, to its surprise, that home-made workers are to be had who can be as competent as any in the world. Our chemists have at last lived down the miserable tradition, arrogantly proclaimed here only so recently as on the occasion of the W. H. Perkin Jubilee by German speakers, that chemistry, especially on the industrial side, is a German prerogative and German chemists a chosen people. Curiously enough the Germans are casting intellectuality aside. The Americans, having few intellectuals, are in a hopeless quandary for lack of higher ideals and inability to look abroad. Now should be our chance. What has the British Association to say at such a period of crisis?

The Presidential Address

This year, the Chair of the Association is filled by the well-known mathematician and theoretical physicist, Sir James H. Jeans, whose popular astronomical writings have made his name a household word. By request, apparently, he has made "The New World Picture of Modern Physics" the subject of his discourse. It may safely be said that no one else could have told the story—the almost incredible story—he seeks to tell, with such grace of style and felicity of diction, in a way to make his hearers believe that they understand. Quite frankly, Sir James makes it clear that he deals with mathematical abstractions—which few can understand. Apparently, we neither know where we are nor shall we ever know. Many of those who listened will have been hypnotised by the beauty of his words. So soothing a dose of British Association "Bluestocking Mixture"—it is well known that the Association is the resort of Bluestockings and their male equivalent—has seldom if ever before been administered; we imagine hearers coming away thrilled, as from hearing a most perfect poem perfectly read—yet without an idea the more for their safe conduct in the world. They will have been entranced, during an hour, by Sir James' soporific—an astounding intellectual feat, in itself remarkable as an example of the penetrative power of the modern mind and its ability to capture images and be filled with them.

It is only possible to talk round such an address: it must be read entire before any true conception of its meaning and message—if indeed it have one—can be gained. The

Sir James Jeans Delivers his Presidential Address at Aberdeen

story can only be made comprehensible in parables, we learn, yet we are cautioned that no parable can remain true, throughout its whole range, to the fact that it is trying to explain. Somewhere or other it must be too wide or too narrow. What of the address? We think of an adage on charity.

"... no parable can remain true throughout its whole range to the facts it is trying to explain. Somewhere or other it must be too wide or too narrow, so that 'the truth, the whole truth and nothing but the truth' is not to be conveyed by parables. The fundamental mistake of the old-fashioned physicist was that he failed to distinguish between the half-truths of parables and the literal truth."

Word Association

Perhaps his mistake was pardonable, perhaps it was even natural. Modern psychologists make great use of what they describe as "word-association." They shoot a word at you and ask you to reply immediately with the first idea it evokes in your uncontrolled mind. If the psychologist says "wave," the boy scout will probably say "flag," while the sailor may say "sea," the musician "sound," the engineer "compression" and the mathematician "sine" or "cosine." Now the crux of the situation is that the number of people who will give this last response is very small. Our remote ancestors did not survive in the struggle for existence by pondering over sines and cosines but by devising ways of killing other animals without being killed themselves. As a consequence, the brains we have inherited from them take more kindly to the concrete facts of everyday life than to abstract concepts; to particulars rather than to universals. Every child, when first it begins to learn algebra, asks in despair "But what are x , y and z ?" and is satisfied when and only when it has been told that they are numbers of apples or pears or bananas or something such. In the same way, the old-fashioned physicist could not rest content with x , y and z but was always trying to express in terms of apples or pears or bananas. Yet a simple argument will show that he can never get beyond x , y and z .

Though this may not attract special notice, it is at least one of the most pregnant passages in the address, calling attention as it does to the limitations innate in the human mind. It is these which so lower our power of dealing with ourselves through education—few are educable.

Mathematical Symbols

"Physical science obtains its knowledge of the external world by a series of exact measurements or, more precisely, by comparisons of measurements. Typical of its knowledge is the statement that the line $H\alpha$ in the hydrogen spectrum has a wave-length of so many centimetres. This is meaningless until we know what a centimetre is. The moment we are told that it is a certain fraction of the earth's radius, or of the length of a bar of platinum, or a certain multiple of the wave-length of a line in the cadmium spectrum, our knowledge becomes real but at that same moment it also becomes purely numerical. Our minds can only be acquainted with things inside themselves—never with things outside. Thus we can never know the essential nature of anything, such as a centimetre or a wave-length, which exists in that mysterious world outside ourselves to which our minds can never penetrate; but we can know the numerical ratio of two quantities of similar nature, no matter how incomprehensible they may both be individually. For this reason,

our knowledge of the external world must always consist of numbers and our picture of the universe—the synthesis of our knowledge—must necessarily be mathematical in form. All the concrete details of the picture, the apples and pears and bananas, the ether and atoms and electrons, are mere clothing that we ourselves drape over our mathematical symbols.”

If only the commercial industrial world could see that knowledge only becomes real when it becomes numerical, expressed by Darwin in his statement—“I have no faith in anything short of actual measurement and the rule of three,” the need of referring all our transactions to some standard of value would perhaps be obvious. The fact that the world now lives only by barter and speculation—the method of the pre-scientific stage of our civilisation only departed from by the few as yet—is our present great difficulty. The Roosevelts have no sense of measurement—at one time their yard is a metre, at another a foot; as yet there is neither scientific sensibility nor scientific sense in the community at large and apparently the economists are most wanting but they are confessedly slow at solving puzzles. The B.A. address unfortunately is too recondite to affect public opinion.

To continue the President's simple story:—

Theoretical Physics

“Theoretical physics is no longer concerned to study the Newtonian universe which it once believed to exist in its own right in space and time. It merely sets before itself the modest task of reducing to law and order the impressions that the universe makes on our senses. It is not concerned with what lies beyond the gateways of knowledge but with what enters through the gateways of knowledge. It is concerned with appearances rather than reality, so that its task resembles that of the cartographer or map-maker rather than that of the geologist or mining engineer.”

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“When geography cannot combine all the qualities we want in a single map, it provides us with more than one map. Theoretical physics has done the same, providing us with two maps which are commonly known as the particle-picture and the wave-picture.”

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The particle-picture is a materialistic picture which caters for those who wish to see their universe mapped out as matter existing in space and time. The wave-picture is a determinist picture which caters for those who ask the question: “What is going to happen next?” It is perhaps better to speak of these two pictures as the particle-parable and the wave-parable.

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The wave-parable serves this purpose; it does not describe the universe as a collection of particles but as a system of waves. The universe is no longer a deluge of shot from a battery of machine-guns but a stormy sea with the sea taken away and only the abstract quality of storminess left—or the grin of the Cheshire cat if we can think of a grin as undulatory.”

This is de Broglie's picture; he would have us see the particle as a collection of waves, its apparent position being where the waves are concentrated.

“The central feature of the particle-picture is the atomicity which is found in the structure of matter. But this atomicity is only one expression of a fundamental coarse-grainedness which pervades the whole of nature.”

The Waves of the Electron

The best we can do with our blunt probes is to represent the position of the electron by a smear and its motion by a moving smear which will get more and more blurred as time progresses.

Now the waves of an electron or other piece of matter are simply a picture of just such a smear. Where the waves are intense, the smear is black and conversely. The nature of the smear—whether it consists of printer's ink or, as was at one time thought, of electricity—is of no importance; this is mere pictorial detail. All that is essential is the relative blackness of the smear at different places—a ratio of numbers which measures the relative chance of electrons being at different points of space.”

Here is argument that will appeal to the Bluestocking. Still wearing them, she will know that the ladder begins at a low point and may stretch even to the knee. Sir James Jeans must be held to have acquired much merit by this address, through the great feat of placing the Electron in the classic groves of *Wonderland*, identifying it with the grin of the *Cheshire Cat*, as an accordion quantity to be used as we please. This at least should be a warning to chemists to let it alone and stick to hard Astonian atoms, for the present; these have sufficient reality, as we count it to-day, to be handled. At the Chemical Society, the portrait of Graham, the solution-motionist, presides over the President: let this be now surmounted by the Grin of the Cheshire Cat—in our mechanical age, to make this a motion-model should not be difficult, to serve as an incentive to readers of papers to be sane. Lewis Carroll, we know, was a mathematician; Sir J. Jeans shows him to have been a magician, ahead of all the Thomsons, the Heisenbergs and the de Broglies; he saw where intellect was leading us. The music that is broadcast by the B.B.C. is understood by few of the hearers but much of it gives pleasure to many. It is clear that modern theoretical physics is just poetry—a dream, not knowledge. Maybe a new Elgar will arise to make it the theme of a new Enigma. Meanwhile there may be wisdom still in the adage:

Il faut cultiver notre jardin

—without mathematics, as we need edible products, no mere “let it be granted”; the chemist has to feed the multitude, not sooth it with soft words nor “charm it with smiles and soap.” Textile workers in the States and Welsh miners spell hard fact; the menace of nordic solidarity is a definite smear at a very central point that may easily be translated into explosive bombs let down from above.

Mud Sheaths in Oil Wells

A Chemical Method of Removal

A CHEMICAL method for effectively removing mud sheaths behind perforated oil strings and liners to permit the oil to enter the wells where formation pressures are low has been devised by engineers of the United States Bureau of Mines.

The removal of these mud sheaths that are deposited against the faces of productive oil sands during rotary drilling, or during subsequent conditioning of wells that are shut in temporarily during periods of over-production, by filling the well opposite the producing formation with mud fluid, is an important problem confronting operators. Certain authorities have estimated that “mudding” or sealing of oil sands has been responsible for the irretrievable loss of millions of barrels of oil in low-pressure sands in California. Different types of mechanical perforation washers, down swabs, and agitators are used at present for breaking down the mud sheaths and removing the disintegrated clay particles from wells after the perforated pipes have been inserted.

The removal of mud sheaths by chemical methods was first suggested to Bureau of Mines engineers by California operators and, as a result, laboratory experiments were performed to investigate the applicability of these chemical methods. The method, described in Report of Investigations 3,249, proposes to add a small amount of calcium carbonate (preferably pulverised limestone) to the mud fluids before they are introduced into the wells. The resultant mud sheaths will be susceptible to disintegration by inhibited hydrochloric acid solutions when it is desired to expose the faces of the oil sands in the wells. The method is based on the well-known fact that effervescence is produced by the escape of carbon-dioxide gas in innumerable small bubbles when hydrochloric acid is brought into contact with limestone.

The laboratory work showed that when 20 to 30 lb. of pulverised limestone (paving dust) is added to the barrel of mud fluid of average weight, the resultant mud sheath could be disintegrated by a 15 per cent. aqueous solution of hydrochloric acid and the oil sand exposed. Inhibited acid solutions are recommended because the addition of an inhibiting agent almost completely arrests the action of hydrochloric acid on oil-well casings and well equipment without affecting the action of the acid on the limestone in the mud sheath. It is believed that results comparable with those found in the laboratory can be obtained in actual wells.

Physical Methods in Chemistry

ONE of the most important features of scientific progress during the present century, and especially since the war, has been the renewal of the old intimate fellowship between chemistry and physics, which was characteristic of the earlier days, when Cavendish and Faraday were masters of both subjects and competent to make important discoveries in either. This was one of the opening statements of Professor T. Martin Lowry, who delivered the presidential address to the Chemistry Section at the meeting of the British Association on September 6. The subsequent segregation, which resulted from the growing specialisation of these two subjects of research, tended to produce chemists who were no longer competent physicists, and physicists who had little or no sympathy with chemical problems, to the great loss of both sciences.

The principal contribution which physics has made to the progress of chemistry during the present century has been the theory of atomic numbers, and the galaxy of phenomena that are associated with it. When the atomic numbers of the elements were made known, through the experiments of Moseley and others, a precise numerical basis was provided for their periodic classification. This finds its simplest expression in the Rydberg series:

$(2 \times 1^2) + (2 \times 2^2) + (2 \times 2^2) + (2 \times 3^2) + (2 \times 3^2) + (2 \times 4^2) +$
which tells us how many electrons are required to give the configuration of the inert gases. These gases owe their inertness to the extreme stability of the "closed shells" of electrons represented by the terms of the Rydberg series. These shells are, indeed, so stable that the elements are devoid of all ordinary chemical properties, although under the stress of great excitement pairs of atoms can be wedded into diatomic molecules.

From the Rydberg series, the electronic theory of valency emerges at once, since maxima of chemical reactivity are found in those metals which can acquire the electronic configuration of an inert gas by parting with one or two surplus electrons, and in non-metals which have a like deficit in their electronic budget. Inorganic chemistry, which consists so largely of the chemistry of ions, thus finds a firm foundation in the Thomson-Kossell conception of "electron transfer" between the atoms of unlike elements. On the other hand, the bonds by which atoms of similar elements are united in diatomic gases, and in the complex molecules of organic compounds, can be expressed by means of the Thomson-Lewis conception of "shared electrons," for which a physical interpretation has now been found in the spinning electron of the older quantum mechanics, and the resonance energy of the later wave-theory.

Chemical Changes in the Nucleus

If the study of the electronic atmosphere is of primary value to the chemist in his studies of chemical reactions, it is impossible to deny that the study of the structure of the nucleus itself is of even more fundamental significance, since it is here that the atomic numbers have their origin. If it were not for the stability of certain selected nuclear structures, the chemist would have no atoms from which to construct his molecules, except perhaps the ultimate elements (apparently once more four in number) from which the nuclei are built. Attention may also be directed to the vast field of nuclear chemistry which has been opened up in recent years by the development of new projectiles for bombarding the nucleus. Thus the relatively clumsy α -particle, with its double positive charge, has been supplemented by the swift proton and deuteron, with only a single positive charge to impede their approach to the positively charged target; and a climax has been reached by using the neutron, which can approach the nucleus without impediment by any electric charge, like aircraft attacking a battleship. It can therefore score direct hits, which are found to have a devastating effect even on the stoutest nuclei. As a result of the introduction of this new projectile, no element can now be regarded as safe from disintegration; and isotopes of short life promise in the future to become as common amongst the lighter elements as they are now amongst the spontaneously radioactive elements,

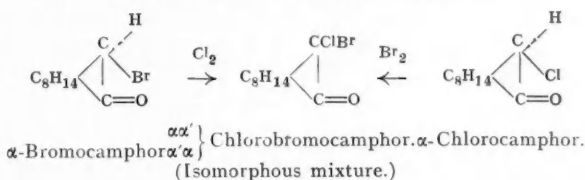
Professor T. Martin Lowry, D.Sc., F.R.S., Reviews the Development of Physical Chemistry during the Present Century

which lie on the heavy side of the boundary formed by metallic lead.

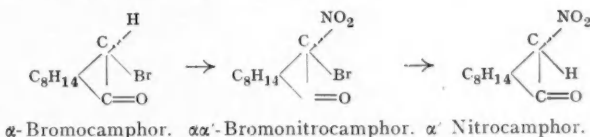
Bombardment need not be used only as an agent of destruction, since Dr. Fraser will tell you how gentle beams, in the form of molecular rays, travelling with the velocity of thermal agitation, instead of with velocities comparable with that of light, can be used to demonstrate the presence or absence of magnetic or electrostatic moments, to study the character of "free radicals," or to test the variability of "dipole moments" with temperature; and Dr. de Laszlo will describe some applications of the method devised by Mark and Wierl for studying the structure of molecules by the orderly scattering of beams of electrons. The results thus obtained are so similar to those given by Debye's study of the diffraction of X-rays as to be almost identical.

Mutarotation

Nearly forty years ago, as a student of organic chemistry under Professor Armstrong, Professor Lowry said that he undertook his first research, on the stereochemistry of the α -derivatives of camphor. The earliest experiments showed that the bromination of α -chlorocamphor and the chlorination of α -bromocamphor both gave an isomorphous mixture of stereoisomeric $\alpha\alpha'$ - and $\alpha'\alpha$ -chlorobromocamphors:



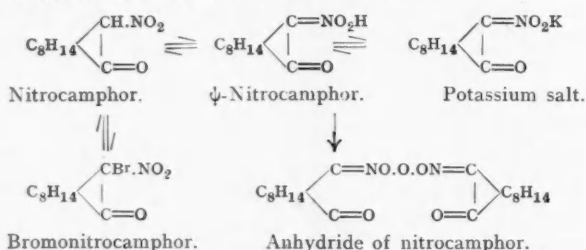
It was then natural to extend the research to the nitro-derivatives. For this purpose it was necessary not only to nitrate bromocamphor, but to brominate nitrocamphor. In this way Professor Lowry first encountered the nitro-compound, which has already provided a material basis for two extensive series of researches, and has not yet exhausted its utility or interest.



The first of a series of happy chances was a measurement of the optical rotatory power of a solution of nitrocamphor in the morning, followed by a confirmatory reading in the afternoon. During the luncheon interval the rotatory power of the solution had become quite different, and Professor Lowry was thus presented with a novel example of the phenomenon of change of rotatory power with time, which Dubrunfaut had first observed in 1846 in a freshly prepared aqueous solution of glucose. This property of the reducing sugars had been variously described as birotation, multirotation, and pauciro-rotation, according as the ratio of the initial to the final rotation was 2:1, greater than 1 or less than 1; but, since in certain solvents the *sign* as well as the magnitude of the rotation of nitrocamphor was changed, he suggested in 1899 that the phenomenon should be described as *mutarotation* and this name has been in general use ever since.

The chemical basis of the phenomenon was disclosed by another happy accident. Wishing to know whether the change of rotary power could be repeated when the nitrocamphor had been recovered from solution, Professor Lowry left a solution in benzene to evaporate on the water bath. Later in the day

he examined the residue and found that it was now almost entirely insoluble in benzene. It had in fact been converted into a new compound, an anhydride formed from nitrocamphor by the loss of half a molecular proportion of water. An anhydride of this type could not be formed directly from nitrocamphor itself, but it could be derived easily enough from an isomeric hydroxylic form of the substance, such as that from which the salts of nitrocamphor were presumably derived. This conclusion was confirmed by the fact that the anhydride of laevorotatory nitrocamphor was, like the salts, strongly dextrorotatory. The mutarotation of nitrocamphor, always from left towards right, could therefore be attributed to a partial conversion in solution of laevorotatory nitrocamphor into a dextrorotatory isomeride, containing an acidic hydroxyl group, which was capable of forming an anhydride as well as a series of salts.



At this stage Professor Lowry prepared a stock of π -bromonitrocamphor. Lapworth and Kipping had described this compound as trimorphous, and had recorded the crystal-constants and published drawings of two of the forms. The orthorhombic form, melting at 142° , proved to be strongly dextrorotatory when dissolved in benzene, but it became laevorotatory after a few hours. The tetragonal form, melting at 108° (which is formed as a by-product, alongside the more stable form, by rapid evaporation of a solution in chloroform), was found to be laevorotatory, but like nitrocamphor it exhibited a relatively small mutarotation from left towards right. This labile form was therefore analogous with ordinary nitrocamphor, whilst the more stable form was analogous with the still unknown pseudo-nitrocamphor, the relative stability of the two isomers having been reversed by the introduction of a halogen. The third form, for which no crystal measurement had been published, was evidently a mere mixture of these two isomers.

Mutarotation of Sugar

The mutarotation of the sugars in aqueous solutions had been attributed to several causes; but, when Emil Fischer observed the same phenomenon during the reversible hydrolysis of the sugar-lactones, he concluded that these changes of rotatory power were due to reversible hydration, and this conclusion was very widely accepted.



This explanation can obviously be applied to any aqueous solution in which reversible hydrolysis can take place; but it was not applicable to nitrocamphor, which exhibited mutarotation in a large range of anhydrous solvents, but was too insoluble to be examined in aqueous solutions. Since interaction with the solvent was thus excluded, the mutarotation of nitrocamphor could only be attributed to dissociation or to isomeric or polymeric change.

At that date certain sugars had already been prepared in two isomeric forms, which exhibited mutarotation in opposite directions; but these changes were attributed to the complete conversion of the two sugars into a third isomeride. In the case of π -bromonitrocamphor, however, the product of mutarotation of the normal and pseudo forms was obviously an equilibrium-mixture of these two substances, and not a third isomeride, since, on evaporation of the solution, crystals of the normal and pseudo forms were deposited side by side. Mutarotation was therefore attributed to the reversible isomeric change of two isomers.

Further fortuitous observations showed that the mutarotation of nitrocamphor is not an independent intramolecular

process, but depends on extramolecular circumstances, since under favourable conditions it may be arrested more or less completely over a period of several days. This discovery (which was made more than twenty years before Kurt Meyer's experiments on the aseptic distillation of ethyl acetoacetate in alkali-free vessels of silica glass) was also the result of a fortunate accident. The mutarotation of a solution of nitrocamphor in chloroform had been followed to completion during a period of about eight days, but had been accompanied by some loss of solvent (and possible concentration of the solution) by evaporation. The remainder of the solution had been left in the small graduated flask in which it had been prepared, and there was no reason to suspect that it would behave in any respect differently from the sample in the polarimeter tube. It was therefore a great surprise when, at the end of seventeen days, on attempting to confirm the final reading, it was found that the residue in the flask gave a rotation almost identical with the initial reading recorded more than a fortnight before. The transfer of the solution to the polarimeter tube, however, sufficed to initiate the mutarotation, which then proceeded with the same velocity as before.

Experiments on Catalysis

Nearly ten years later a further series of experiments was being made on the catalysis of mutarotation by acids and bases. It was then observed that solutions of nitrocamphor in chloroform, to which trichloroacetic acid had been added, developed an intolerable and pungent odour. This observation showed that the peculiar inertness of chloroform was due to its oxidation to carbonyl chloride or phosgene, and to the consequent elimination of traces of nitrogenous bases, in the form of inert carbamides. The same series of experiments had already shown that some of these bases have an amazing catalytic activity. Thus an acceleration of mutarotation was detected as a result of adding piperidine to benzene in the proportion of 1 part of the base in 10 million parts of the solvent! An immediate sequel to this discovery was the arrest in silica vessels of the mutarotation of solutions of nitrocamphor in benzene and in ether, to which traces of an anticatalyst had been added. Subsequent experiments showed that mutarotation could also be arrested in solutions of tetramethylglucose in chloroform, benzene, ethyl acetate, and pyridine. The climax of this work was reached when Faulkner found that the mutarotation of tetramethylglucose could be arrested both in cresol and in pyridine, but proceeded too rapidly for convenient observation in mixtures of these two solvents.

Rotatory Dispersion

At the time when the earlier measurements of mutarotation were made, it was customary to measure the optical rotations of organic compounds only for the yellow sodium line. Work on rotatory dispersion had indeed been suspended almost completely since the death of Biot in 1862, and the discovery of the Bunsen burner in 1866. It was, however, certain that little progress could be made in elucidating the origin of optical rotatory power, or in predicting its magnitude, until the values of the rotatory power were known over a wide spectral range, instead of for a single casually determined point on the curve of rotatory dispersion. This opinion has received abundant confirmation from the subsequent demonstration that the substances which had provided the favourite materials for studies of optical rotatory power were those whose rotatory dispersion was most anomalous, since these substances are in fact (and perhaps inevitably) most sensitive to changes of solvent, concentration, or temperature.

Experiments carried out in order to supply the data required to determine the form of the curves of rotatory dispersion in organic compounds soon led to definite conclusions. Thus in 1913 Professor Lowry was able to show, with T. W. Dickson, that the optical rotations of ten simple alcohols, and the magnetic rotations of thirty-four simple organic compounds for eight wave-lengths in the visible spectrum could be expressed by one term of Drude's equation:—

$$\alpha = k'(\lambda^2 - \lambda_0^2).$$

In the next year they found that two terms of opposite sign:

$$\alpha = \frac{k_1}{\lambda^2 - \lambda_1^2} - \frac{k_2}{\lambda^2 - \lambda_2^2}$$

could be used in the same way to express the anomalous

rotatory dispersion of ethyl tartrate. This result confirmed the conclusion reached at a much earlier period by Biot and by Arndtsen, that anomalous rotatory dispersion has its origin in the superposition of two partial rotations of opposite sign and of unequal dispersion. These partial rotations may be due to very diverse causes, ranging from the presence of two optically active absorption bands in the same molecule, to the case in which two liquids of opposite rotatory power and unequal dispersions are arranged in series in separate polarimeter tubes.

Origin of Optical Rotatory Power

Attempts to simplify the structure of an optically active molecule for the purpose of numerical calculations have been made by Drude, who used a model consisting of a vibrator moving in a spiral orbit, whilst Kuhn has used a model consisting of two dissymmetrically coupled electrons. Each of these models includes a *length*, namely, the pitch of the spiral or the distance between the coupled electrons, and it is perhaps not surprising that they have led to equations which differ only in the meaning assigned to the arbitrary constants; but in certain cases at least the length deduced from Kuhn's model appeared to bear no relation to the linear dimensions of the molecule. Fortunately the formulæ which express the rotatory dispersion of a medium do not depend on the nature of the model used to deduce them, although new integrals are required to correspond with each new dis-

tribution of densities in the optically active absorption band. This distribution depends on the intensities of the sub-levels associated with a given electronic jump, and cannot yet be predicted.

It appears that the molecular theory of optical rotatory power, as de Malleman has called it, is not capable in its present form of expressing the rotatory power of any but the simplest molecules; and the crudeness of some of the assumptions on which it is based, and the importance of the secondary effects which it ignores, forbid any expectation of extensive developments in the near future. Nevertheless the theory has proved to be of real value in demonstrating the simplicity of the conditions which suffice to give rise to optical rotatory power, since this effect can be produced by four isotropic spheres which are near enough to pass on to one another the alternating polarisation produced by an incident beam of light, without requiring any more complex form of coupling; and chemists will always be grateful for a theory of optical rotatory power which makes it possible to identify the actual configurations of the dextro- and laevorotatory forms of the simplest organic molecules, in parallel with a similar claim which has recently been made by Kuhn in the more complex case of the spiro-compounds. On the other hand, no theory of optical rotatory power which is limited to the region of transparency can be regarded as satisfactory, and further progress must depend on an intensive study of rotatory dispersion in the region of absorption.

Chemistry at the British Association

Some Further Contributions to our Knowledge of Vitamin C, Molecular Rays and the Optical Properties of Conjugated Compounds

FOLLOWING the presidential address to the Chemistry Section by Professor T. M. Lowry, F.R.S., on Thursday, September 6, Dr. R. G. J. Fraser dealt with "Applications of Molecular Rays to Chemical Problems." He said modern vacuum technique allows the production of beams of neutral molecules, moving with thermal velocities *in vacuo*. Hence molecular properties can be studied directly, without the necessity for statistical arguments. Applications of the method more immediately touching chemical problems are four in number. In the first place, if a non-magnetic diatomic molecule dissociates into magnetic atoms, and a mixed molecular-atomic beam is sent through an inhomogeneous magnetic field, the atoms suffer deflection, the molecules are unaffected. Thus the atoms and molecules can be physically separated, and their relative numbers determined. Secondly, the weakening of a beam of molecules on traversing a vapour determines their mean free path and collision area Q . Methods have been devised which permit extrapolation to beams of negligible width. Hence Q values are obtained which are independent of the geometry of the apparatus. Thirdly, the deviation of a beam in an inhomogeneous electric field determines the molecular dipole moment μ . The dipole moment is measured outright, at a single temperature. Hence a possible dependence of μ on temperature is readily established. Fourthly, a molecular ray is collision free; hence the primary products of chemical reactions can be isolated in the beam and examined by special methods.

A paper on the "Determination of Molecular Structure by Electron-Diffraction" was read by Dr. H. de Laszlo. He pointed out that the technique of obtaining photographic records of the scattering of fast electron beams by vapours and gases has been simplified and perfected in several ways. The interference pattern of the vapour of any substance that will vaporise *in vacuo* up to 1,000° C. without decomposition can be photographed by means of a small oven, equipped with an original type of vaporising nozzle. This permits the investigation of a great variety of molecules which could not have been measured by the older methods. This nozzle, either in conjunction with the oven or by itself when using substances with a high vapour pressure at room temperature,

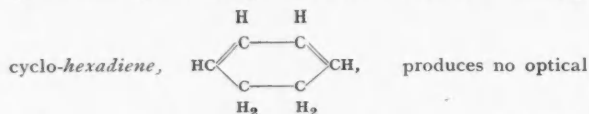
coupled with the use of Ilford X-ray emulsions, enables one to record many more interference maxima than had previously been possible. These new high order maxima are particularly sensitive to changes in chemical structure. Hence we can now make an accurate determination of interatomic distances and the molecular architecture of many substances whose spatial configuration has hitherto been unknown. The high $(\sin \theta/2)/\lambda$ values of the maxima that are now available permit the use of a simplified method of calculating the theoretical scattering curves, with which the experimental results are compared, with a consequent saving in time. These technical improvements have turned the electron-diffraction method into a quick, reliable, and accurate tool for the determination of chemical structure in the vapour phase. It should now be possible to clear up most of those debatable points in chemistry where a knowledge of the spatial structure is essential.

Measurements on the refractive indices, etc., of pure compounds have led to the view that the atoms in a molecule are polarised under the action of the electric field of a light wave, said Mr. S. F. Boys in his paper on "The Origin of Optical Rotatory Power." If an asymmetric molecule is examined and the atoms are assumed to have the usual polarisabilities, it is possible to calculate the complete optical properties of the liquid composed of such molecules. If the liquid only contains one of the two enantiomorphs, the calculation shows that, in general, the liquid must rotate the plane of polarisation of a transmitted light wave. The predicted values of the optical rotatory powers of certain simple compounds, e.g., amyl alcohol, have been found, and these agree with the experimental values. The calculation makes it possible to state the conditions which determine whether a given simple molecule is dextrorotatory or laevorotatory. This relation can be used in the reverse sense and it is possible to determine the absolute configuration of some optically active compounds.

Mr. E. Eastwood and Dr. C. P. Snow jointly dealt with "The Absorption Spectrum of Acrolein." Unlike the saturated aliphatic aldehydes, which give very complex band spectra, acrolein, $\text{CH}_2=\text{CH}-\text{CHO}$, gives a band spec-

trum in which the rotational structure is as sharp as in the diatomic gases. This structure, however, presents the unique anomaly that the moment of inertia deduced for the ground state of the molecule, instead of being constant throughout, is different for each vibrational band.

A further paper on optical properties of conjugated compounds, "The Origin of Optical Exaltation in Conjugated Hydrocarbons," was read by Dr. C. B. Allsopp. Contrary to the prediction of Brühl, but in confirmation of observations by Willstätter, the conjugation of two double bonds in 1:3-



exaltation in the visible spectrum, although the molecular refraction M_D of 2:4-hexadiene, $\text{CH}_2 = \text{CH} = \text{CH} = \text{CH} = \text{CH}_2$, is 1.65 units higher than that observed in diallyl, $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{CH}_2$, where the two double bonds are isolated from one another by three single bonds. Exaltation is observed, however, at wave-lengths in the vicinity of a strong ultra-violet absorption band which is characteristic of the conjugated system. The magnitude of the optical exaltation will depend on the position and intensity of this absorption band, which may be influenced by many factors. It is suggested that one of these factors may be the relative orientation of the conjugated double bonds,



which can take up parallel configuration, (a) in open-chain compounds, but are held in an inclined configuration, (b) in ring compounds.

History of Vitamin C

On Friday, September 7, there was a discussion on ascorbic acid (vitamin C). Professor A. Harden, F.R.S., reviewed the history of vitamin C. He said it was recognised as early as 1734 that scurvy was due to the lack of fresh vegetable food and could be cured by the supply of this. In 1907 scurvy was "brought into the laboratory" by Holst and Frölich, who, using the guinea-pig, made a rough and mainly qualitative survey of the antiscorbutic potency of foodstuffs and studied the effects of heat and preservation on this property. Fürst, in the same laboratory, also found that in leguminous seeds antiscorbutic potency arose during germination. Strictly quantitative observations soon followed, first in England and then more generally, and it was found that the antiscorbutic vitamin, as it was now called, was very unequally distributed among vegetables and fruits, etc. Studying the physical and chemical properties of the vitamin, Zilva, of the Lister Institute (1924 and onwards), succeeded in concentrating it about 200 times and found that the preparations always had strong reducing properties. Removal of the reducing power by titration with indophenol did not inactivate the preparation, but this soon became inactive on keeping.

In 1932 Tillmans and Hirsch confirmed these facts, but showed that the oxidation by indophenol was reversible and that the facts were consistent with the conception that the vitamin itself had reducing properties. They further suggested that it might be identical with the strongly reducing hexuronic acid found in the adrenals and in many vegetable juices by Szent-Györgyi (1928). The discovery by the latter (1932) that this acid, henceforward to be known as ascorbic acid, had powerful antiscorbutic properties soon led to a general agreement that ascorbic acid was vitamin C. The easy preparation of this substance in quantity from paprika provided material for the determination of its constitution at the University of Birmingham (March, 1933), and this was rapidly followed by the synthesis of the acid (August, 1933) both in Birmingham and in Switzerland and the demonstration of the full antiscorbutic potency of the synthetic substance.

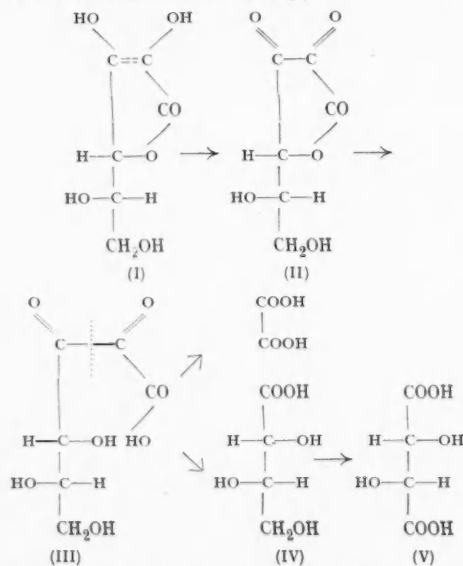
Dealing with the isolation of ascorbic acid and its identity with vitamin C, Professor A. Szent-Györgyi said there seems to be no cell life in higher organisms without ascorbic acid. The exact biological rôle played by this substance is, however, unknown. The most characteristic chemical feature of ascorbic acid is its high reducing power and the reversible nature of its oxidation. There is little doubt that the biological

function of this substance is connected with this reaction. In spite of its simple chemical structure *L*-ascorbic acid is a highly specific substance. Closely related substances with the same reducing power (for example, its stereoisomers) are unable to replace it in biological reactions. Not all animals are dependent on their food for ascorbic acid. All animals of our climate are capable of synthesising it. The inability of man to produce it pleads for his tropical origin.

Ascorbic acid having become available for medicine only very recently, its medical applications are not yet sufficiently settled. The first clinical medical experiments, however, have revealed some very striking and unexpected effects. Ascorbic acid seems to be able to cure in a very striking manner several diseases against which medicine was helpless, such as *purpura hæmorrhagica*, *Werlhoff's disease*, certain forms of *hæmorrhagica nephritis* and *hæmophilia*, *pyorrhæa*, etc. This is the more striking since these pathological conditions have not been thought to be connected with lack of vitamin. These curative effects suggest that humanity is suffering much more gravely from a lack of vitamin C than has hitherto been supposed. Also the major part of pathologic pigmentations can be made to disappear by ascorbic acid. So, for instance, patients with *Addison's disease* can be bleached out again by the use of this substance. We thus see that, in the short space of time of two years, the mysterious vitamin C has been identified, its chemical structure determined, its synthesis effected. It has also been made available for industry and medicine, and its medical value ascertained.

Chemical Properties and Structure

The chemical properties and structure of ascorbic acid were discussed by Dr. E. L. Hirst, F.R.S. Insight into the chemical structure of ascorbic acid, he said, originated from a study of its oxidation products. The first (reversible) stage terminates with the formation of an α , β -diketo-acid (III), which on more drastic oxidation gives rise to oxalic acid and *L*-threonic acid (IV), the constitution of the latter being proved by its transformation into *d*-tartaric acid (V). The stereochemical relationships and the main features of the structure of ascorbic acid were thus elucidated. Further advance became possible with the discovery that the first oxidation product at the moment of its formation is not the acid (III) but a lactone (II) which subsequently hydrolyses to the free acid. It followed from this observation that ascorbic was not a carboxylic acid but owed its acidic character to the presence of an enolic hydroxyl group. At this stage of the investigation (March, 1933) sufficient chemical and crystallographic evidence had accumulated to support the proposal of the structural formula (I).



It remained only to decide whether a γ -(1:4) or a δ -(1:5) lactone ring was present, and in April, 1933, a clear decision in favour of the γ -lactone structure was obtained from investigations on the tetramethyl ether of ascorbic acid. This

substance gives on degradative oxidation a dimethyl *L*-threonic acid which has the free hydroxyl group in the α -position. The presence of a λ -lactone in ascorbic acid (I) was therefore definitely established. Confirmation of these views was then provided by the synthesis of ascorbic acid from *L*-xylosone.

Crystallographic contributions to the study of ascorbic acid were introduced into the discussion by Mr. E. Gordon Cox. He pointed out that the unusual chemical properties of ascorbic acid are such that at an early stage in the study of its constitution it was possible to suggest two or three spatial formulæ, any one of which, however, could only be finally established or eliminated by much time-consuming study. Any additional experimental method which could be used to discriminate between the possibilities was therefore of great value. Whilst it is usually very difficult to prove the correctness of a given structure by the use of X-rays, it is often relatively easy to eliminate suggested alternatives. This was found to be so in the present case. Of the constitutional formulæ proposed only one was found to fit the observed optical and X-ray data. In a relatively short time this formulæ was established by chemical methods as correct. During this latter stage of the work, X-ray methods were again found to be of use in determining molecular weights and identifying degradation products, especially in cases where the yield was very small, or where melting point was uncertain.

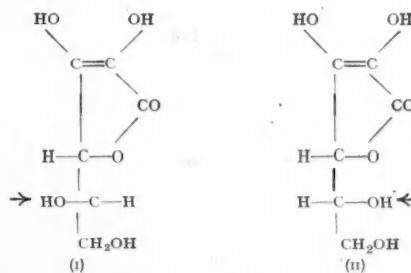
The next step, that of synthesis, was also assisted by crystallographic methods. In the early stages work was naturally on a small scale, with correspondingly small yields; X-rays and microscopic examination were used to identify products and thus to prevent waste of time and material on syntheses under unfavourable conditions.

The first effort of Reichstein, Grüssner and Oppenauer in the field of ascorbic acid is not the only example of synthetic studies which, though based on incorrect suppositions, have turned out successful, said Dr. T. Reichstein, in speaking of investigations in the field of ascorbic acid and related substances. At the time when he and his collaborator began their work the incorrect furoid formula of Micheel and Kraft had just appeared. Being himself a furan specialist, this formula stimulated his curiosity. Attempts were made to find models containing an endiol group, and the probable influence of ring structure was studied. Efforts were also made to synthesise substances analogous to ascorbic acid (3-keto-sugar acids) and also ascorbic acid itself. Two methods were developed. In the first place, he attempted a rearrangement of 2-keto-acids (osonic acids), while his collaborator, R. Oppenauer, proposed the treatment of osones with hydrocyanic acid. Positive results were first obtained

from the latter. The former was the more difficult, since the appropriate 2-keto-acid was not available, and the necessary conditions to induce it to enolise were not quite those expected.

A final contribution to the discussion came from Professor W. N. Haworth, F.R.S., whose subject was the synthesis of ascorbic acid and its analogues. The experimental methods which have been applied at Birmingham for the synthesis of *D*- and *L*-ascorbic acid may be summarised as follows: (1) Addition of hydrogen cyanide (reagents potassium cyanide and calcium chloride) to *L*-xylosone, yield 70 per cent. (2) oxidation of gulonic acid direct to 2-keto-gulonic acid, followed by isomerisation by the method of Ohle ("Z. Angew. Chem.," 1933, 46, 399) and of Maurer ("Ber.," 1933, 66, 1054). (3) Direct oxidation of sorbose to 2-keto-gulonic acid followed by isomerisation. In addition, the same methods have led to the synthesis of seven isomers or analogues of the natural vitamin. The fact that arabinosone by the potassium cyanide method gave the same product as that of Ohle and Maurer (isomerisation of a 2-keto-gulonic acid) showed that either a 2- or a 3-keto-hexonic acid could isomerise to the same ascorbic acid type.

The synthetic *L*-ascorbic acid (I) has the same physiological activity as the natural product (Haworth, Hirst and Zilva). Of the isomers and analogues obtained so far only the *D*-arabo-ascorbic acid (II) shows activity which is in the least comparable.



The above configurations (projection formulæ) are identical with respect to the stereochemical arrangement of groups attached to the ring and differ only by the reversal of one OH-group in the side chain. If this principle holds we should expect also the following, which are in course of preparation, to show some physiological activity: *L*-gulo-ascorbic acid and also the *L*-galacto, *D*-allo- and *D*-erythro-ascorbic acids.

Drug and Fine Chemical Workers New Draft Agreement Submitted to Employers

DURING 1933 a movement for revised wages and conditions was started among the members of the Chemical Workers' Union employed by sixty-seven of the principal firms in the drug and fine chemical trade, with factories in London, Manchester, Liverpool, Leeds, Sheffield, York, Bristol, Coventry, Birmingham, Leicester, Derby, Stockport, Nottingham, Glasgow and Edinburgh, employing an aggregate of 20,000 workers. As the result of the movement, the Union executives was instructed to draw up a new agreement, and the terms were submitted to a national ballot of the workers concerned in April, resulting in a majority vote of 17 to 1 in favour of the terms. The voting also involved an instruction to the executive to apply direct to all the firms concerned for consideration and acceptance of the new agreement. These applications were issued from the headquarters of the Union on Monday of this week.

The main features of the new draft agreement, and their relation to existing conditions, are as follows: Hours, 40 per week (against 48); overtime, pay and a half (against pay and a quarter for the first two hours and pay and a half afterwards); holidays, 12 days (against six). In the case of the wages of foremen, forewomen and charge hands there are no

existing terms, but the new proposals are: Foremen, 100s.; forewomen, 50s.; charge hands, male 90s.; female, 45s. For other grades the proposals are: Males, grade 1, 80s. (against 60s.); grade 2, 70s. (against 55s.); grade 3, no figure stated (against 50s.); females, grade 1, 40s. (against 34s.); grade 2, 35s. (against 28s. 6d.).

For junior labour the proposals are: Males, aged 14, 14s. (against 11s. 6d.); aged 15, 16s. (15s.); aged 16, 20s. (19s.); aged 17, 30s. (22s. 6d.); aged 18, 40s. (27s.); aged 19, 50s. (31s. 6d.); aged 20, 60s. (36s. 6d.). Females, aged 14, 14s. (against 11s.); aged 15, 15s. (13s.); aged 16, 18s. (15s. 6d.); aged 17, 21s. (18s.); aged 18, 24s. (20s.); aged 19, 27s. (22s. 6d.); aged 20, 30s. (25s.).

Other new proposals concern the restriction of junior labour to one to every four adults, payment of male wage rates to females engaged on work normally done by men, and the payment of compensation to workers discharged through reorganisation on the basis of two weeks' wages for each complete year of service. It is also proposed that all junior labour should be regarded as "improvers" and should work in association with adults, with at least one adult in every department.

Economic Batch Size is an Important Factor in Manufacturing Costs

By H. LEWIS, B.Sc., A.M.I.Chem.E.

THERE are numerous instances in the chemical industry in which the theoretical ideal of a continuous process is not a practical proposition, due to the size of the operation, and manufacture is carried on by the batch method. Batch operation may not only be necessary because of size restrictions but also may be due to the nature of the process, such as with reactions under pressure or with certain mixing operations of very viscous materials, as encountered in the paint and similar industries.

Four Important Factors

The true economic batch size will be dependent upon (a) the market for the product, taking into account not only the present selling price but also market trends with product volume; (b) the investment cost, particularly the question of the variation of the cost of the plant in relation to the output; (c) overhead charges; and (d) operation charges, especially the relationship between the amount of supervision and labour required and the number of units of plant. Batch operation is also subject to the specific consideration of the question of the relation between the efficiency of the operation and the batch size, thus, in the mixing of a solid with a very viscous liquid, it may be possible to overload the plant, requiring an excessive mixing time in proportion to the output. All these considerations, however, relate to the choice and installation of plant, but as batch operation more usually occurs in the smaller industrial firms, where the initial investment cost is of paramount importance, due to capital restrictions, it is of more interest to consider the particular question of the economic batch size in the case of a plant already installed and which has to function in several different manufacturing processes. In this case batch time will be given the specific meaning of the time between two different processes.

In the determination of the economic batch size, use can be made of the methods adopted in the mechanical engineering industries when manufacturing components for stock. The factors involved in the total production time are first, preparing the machine for the work, called the "set-up time"; secondly, the actual time of operation. Many processes in the chemical industries involve a similar set-up time, thus for instance, if an edge-runner has been used for the mixing of black paint, it is necessary to clean the plant thoroughly before using it in the manufacture of lighter shades, also, a machine used for filling tubes with tooth paste will necessitate cleaning before being used, say, for shaving cream. Similar problems are met with in all industries manufacturing a variety of products, although the actual set-up time will vary considerably, from the time required for the thorough cleaning before using a catalyst in a subsequent process to the small degree required when milling household soap dyes using an increasing colour-depth in order of manufacture of the various shades.

Manufacture for Stock

All too often is control of manufacture based entirely on orders received, with a consequential necessity for continual process change and repeated cleanings, set-up time then acquiring an important aspect in the manufacturing cost. For efficient industrial administration, the question should be tackled from a strict economic viewpoint, and manufacture for stock must be taken into consideration.

It is first necessary to examine the effect of set-up time on the unit cost, and this is best done by considering two fictitious examples. Assuming that the operation and the cleaning are done by the same operator, *i.e.*, the labour cost per machine-hour is constant, then the cost can be equally well represented by time units as by cost units. In the first case let the set-up time be 50 mins. and the time for making one unit of manufacture be 1 min., and in the second case, with the same set-up time, let the unit operation time be 30 min. The following table gives the relation between the size of the batch and the manufacturing time per unit:—

Size of batch (<i>i.e.</i> , number of units).	Set-up time.	Operating time.	Total time.	Manufacturing time per unit.
Case 1.				
10	50	10	60	6.00
20	50	20	70	3.50
50	50	50	100	2.00
100	50	100	150	1.50
200	50	200	250	1.25
500	50	500	550	1.10
1000	50	1000	1050	1.05
Case 2.				
10	50	300	350	3.50
50	50	1500	1550	3.10
100	50	3000	3050	3.05
200	50	6000	6050	3.03

It is obvious that decrease in set-up time in relation to unit operation time causes the actual unit manufacturing time to approach its limiting value more quickly. When the limiting value is approached, further increase in batch size will be outweighed by the disadvantages of excessive stock. Too much stock represents idle capital, and in some cases there may also be the risk of stock deterioration or obsolescence.

The problem of economic batch size can, with advantage, be subjected to an approximate mathematical analysis. Let T be the total cost of unit manufacture, which will include (a) actual cost of the raw materials; (b) proportion of the set-up cost; and (c) interest on the capital laid up during storage (including depreciation, obsolescence, etc.). A convenient figure to take for (c) is 10 per cent. per annum, and this will be used in the following analysis. Also let M be the "movement," *i.e.*, the number of units sold per month, S be the set-up time in cost units, C the cost of raw materials per unit, and X be the number of units in the batch. Then the cost of raw materials and set-up, *i.e.*, the capital stored, is $(CX + S)$, but, since the movement will be assumed regular, it is obvious that the average stock will be only half that of the batch size, hence the average capital lying idle in store is $\frac{CX + S}{2}$.

The annual interest and depreciation on this capital at 10 per cent. will be $\frac{10}{100} \times \frac{CX + S}{2}$, and as the total units of manufacture per year is $12M$, the storage interest per unit will be $\frac{10}{100} \times \frac{CX + S}{2 \times 12M}$.

The set-up cost per unit is obviously S/X , hence the total unit production cost is given by

$$T = C + \frac{S}{X} + \frac{10}{100} \times \frac{CX + S}{2 \times 12M}$$

$$i.e., T = C + \frac{S}{X} + \frac{10}{240M} \times \frac{CX + S}{2}$$

For T to have a minimum value, $\frac{dT}{dX}$ must equal zero, hence

$$\frac{dT}{dX} = -\frac{S}{X^2} + \frac{10}{240M} \times \frac{C}{2} = 0$$

$$\text{Therefore } X_{\min} = \sqrt{\frac{240MS}{C}}$$

Often the movement is not regular as assumed in the mathematical analysis, special emergency orders always being a feature of the smaller industrial organisations, and the formula will obviously have more value in such engineering processes as the manufacture of components for automobiles, yet an approximate evaluation of the economic batch size will be of assistance in effective administration.

The Chemical Industries of France—II

ACCORDING to the report on "Economic Conditions in France," dated June, 1934 (H.M. Stationery Office, price 7s. net), from which we published extracts last week (pp. 187-190), France still occupies a leading place in the electro-chemical and electro-metallurgical industries as a consequence of the development of her hydraulic power and of her resources of bauxite. The shares and debenture capital invested have increased from 735 millions in 1920 to 1,800 millions in 1931; and the total electric power of the undertakings—now about sixty in number—was estimated to be 711,000 kilowatts, compared with 206,000 in 1910.

The fourteen aluminium works, of which eleven are in the Savoy Alps and three in the Pyrenees, employ about three-sevenths of this power, the chemical (calcium carbide, chlorate, sodium and by-products) works about a quarter, the balance being utilised in the production of electric furnace pig iron and steel, ferro-alloys such as ferro-manganese, ferro-

Main Branches Organised on a Large Scale and Controlled by Few Groups

powder and explosives, and gas, the total was then brought to nearly 250,000.

Within this total, the categories having in 1926 over 4,000 employed persons were: gas, 44,000; heavy chemicals (acids, salts, etc.), 36,000; tobacco and matches, 18,700; perfumes, 15,600; pharmaceutical products, 14,600; fertilisers (super-phosphates, etc.), 13,600; powders and explosives, 11,300; dyestuffs, 13,030; vegetable oils, 11,100; pencils, inks, varnishes, polishes, 7,730; soaps and glycerines 6,600; refuse removal, etc., 4,600; and tallow and candle making, 4,250. From 1926 to 1930 the numbers considerably increased, and the subsequent losses in labour power through trade depres-



Sulphuric Acid Plant at the Casablanca works of the well-known French chemical firm, Etablissements Kuhlmann, reproduced from a commemorative Centenary volume published in 1926.

chrome, ferro-vanadium, ferro-molybdenum, ferro-tungsten, and so forth. The output of aluminium rose from 13,500 tons in 1913 to 27,000 in 1928 but fell to 24,400 in 1931 and 14,100 in 1932; the present capacity is stated to be 35,000 tons. Magnesium, a metal lighter than aluminium, has also made great progress in France by its use in the motor-car and aviation industries; it is now produced by electrolysis of chloride of magnesium, which is of sea-salt origin.

The present output of chlorates is 10,000 to 12,000 tons per year: that of gaseous chlorides is nearly 35,000 tons, and that of chloride of lime 25,000 tons. Carbide of calcium, 41,000 tons in 1913, rose to an average of 72,000 tons for 1924-27, and to 88,000 and 105,000 tons in 1929 and 1930.

Scale of the Industry

Since war necessities crudely revealed the serious gaps in her chemical self-sufficiency, the chemical industries of France have developed a growing force in her economic life; and they have achieved a notable advance in recent years. The census of 1926 showed that, since 1921, the number of persons employed had risen from 190,500 to 218,000; including the additional 30,000 employed in State, county, or municipal undertakings in the manufacture of tobacco and matches,

sion have been somewhat compensated by the new extensions in oil refining, distillation of coal products and alcohol, electro-chemical, electro-metallurgical and other branches. The total amount of capital invested, excluding participations of chemical firms in other industries, is estimated at from 12 to 15 milliards of francs.

In value of output, the chemical group of industries takes seventh rank, after coal, engineering, metallurgical, silk, cotton, and woollen industries: in 1929, its turnover was estimated at from 10 to 12 milliards. In value of exports, it takes fourth place: thus, in 1930, they amounted to 3.20 milliards, or 7.5 per cent. of the total, as compared with 6.64 milliards for textiles, 5.22 milliards for engineering, and 3.53 milliards for metals. In 1928 France took fourth place for her part in world production, which was 7 per cent.; for the United States, 45.8 per cent.; for Germany, 16.7 per cent., and for Great Britain, 12.5 per cent. She also takes fourth place in foreign trade.

The chemical industries are dispersed to a great extent throughout France. The predominant areas are those of Paris, Marseilles, the Nord county, Lyons and Rouen. Alsace is important for its potash and mineral oil (Pechelbronn) mines, and for its textile dyeing and printing; and Lorraine

for its great salt mines and soda works near Nancy, and for the large output of coke with by-products and of basic slag from a metallurgical industry representing nearly two-thirds of the national power in this respect. As to the Paris area, in the capital itself, which (1926) had 19,000 persons in the industry, 5,000 were engaged in pharmaceutical production, 9,400 in the coal, petrol and wood distillation, and 2,100 in dyes, paints, varnishes, etc. Of the 45,000 in the Paris suburbs, 13,000 were engaged in vegetable oils, perfumes, soaps; 12,000 in coal, etc., distillation; 7,000 in dyes, paints, etc.; 4,500 in pharmaceutical products; 4,300 in animal oils, glue, etc.; 4,000 in heavy chemicals (acids, salts, etc.). In the two counties near Paris, Seine-et-Oise and Seine-et-Marne, considerable further production takes place in coal distillation and in pharmaceutical goods, whilst near Creil, in the adjoining Oise county, is the headquarters of the dyestuffs output, and, in the Aisne, the next county, the chief heavy chemical and glass works of the other principal group.

Chemical Importance of the North

The north has its special chemical importance from the by-products of its coal and coke industries (which are the greatest in France); and in its area are considerable numbers of other chemical manufactures, acids, salts, superphosphates, starches, soft soap, candles, perfumes, oil refining, fertilisers. Of the 11,300 persons in the chemical trades in the Rouen area, 6,500 were engaged in distilling coal, petrol and wood; 1,550 in acids, salts and fertilisers; and 1,200 in mineral oils, salts, etc.

Since the year 1931, oil refining occupies a very important place in the Rouen-Havre area. Marseilles is easily the predominant centre for oilseed crushing and hard soap manufacture: in 1926, out of 17,400 chemical workers, 9,555 were engaged in soap, candles and perfume making; 4,000 in heavy chemicals (salts, acids, etc.); 2,120 in the distillation of coal, petrol and woods; and nearly 1,000 in animal fats, glue and fertilisers. Since 1931 it has, like Rouen, been an important oil refining centre. The Lyons area returned 12,600, of whom 3,500 were in heavy chemicals; 3,025 in coal, petrol and wood distillation; 2,400 in dyestuffs, inks and varnishes; 1,015 in pharmaceutical products. In the counties of the Haute-Savoie and Isère, close to Lyons, are found the main electro-chemical and electro-metallurgical works: out of 2,000 in the former, 1,600 workers are so engaged; and in the Isère about 600; the bulk of the remaining output takes place in the Hautes-Pyrénées country.

Scale of Undertakings

In comparison with the conditions prevailing in the United Kingdom, Germany, and the United States, the great majority of French chemical undertakings appear to be organised on a medium or small scale. Out of the 6,010 separate chemical establishments recorded by the 1926 census, only 17 employed over 1,000 persons: they included six gasworks, four perfumeries, two general heavy chemicals, one soda, one petrol, one vegetable oils, one stearine and candle, and one artificial or electric coal works. Even in the category with from 501 to 1,000 persons only 36 firms appear: 13 are in the coal, petrol, etc., distillation group, 12 in the acids, salts, etc., group, six in the dyestuffs paints and varnishes, etc., group, two in the vegetable oils, two in fertilisers, etc., and one in electro-chemical works. The number of persons in these 53 works with over 500 persons totalled 55,000, or a little more than one-fifth of all employed.

The medium establishments with from 201 to 500 persons numbered 142 with 42,200 persons: 43 in the coal, etc., distillation group, 26 in animal oils, fertilisers, etc., 25 in heavy chemicals, 18 in vegetable oils and soap, 11 in electro-chemicals and explosives, nine in pharmaceutical and nine in dyestuffs, varnishes, etc. The third group of 240 undertakings, with from 101 to 200 persons, and employing a total of 33,000 persons, showed 72 in coal, etc., distillation, 46 in vegetable oils, 27 in pharmaceutical, 21 in dyestuffs, 10 in electro-chemicals and explosives. Of the smaller-scale groups, the fourth (with 51 to 100 persons) showed 399 establishments with 27,900 persons; the fifth (21 to 50) 800 establishments with 25,860 persons; the sixth (11 to 20) 816 establishments with 12,200 persons; and the seventh (six to 10) 953 establishments with 7,413 persons. It is perceived that, out of

the 6,010 establishments, only 195, with 97,333 persons, fell in the categories of over 200 persons, and another 240, with 33,000 persons, in that of from 101 to 200.

Group Concentration Developments

Despite the variety and multitude of the undertakings, many main branches of the French chemical industry are organised on a large scale, and are controlled by a few concerns or groups, whose ramifications in all directions are apt to baffle any ready computation. The heavy chemicals are dominated by three groups, Kuhlmann, St. Gobain, Bozel-Malétra, which do not, however, necessarily confine themselves to heavy chemicals: the electro-chemical and electro-metallurgical by the Alais, Froges et Carmargue group, which, among other things, produces about nine-tenths of the aluminium: oxygen, hydrogen, nitrogen, acetylene, synthetic ammonia, by the Air Liquide, connected with St. Gobain, Grande Paroisse, coal mines, and others, as well as by the State (at Toulouse): and coal tar products by the gas companies. Kuhlmann and St. Gobain in conjunction with coal mines.

Potash output is in the hands of the State (two-thirds) and of one company (one-third), and its sale in those of a single organisation. Dyestuffs are produced to the extent of nine-tenths by the Kuhlmann group, the remainder by a company in which Kuhlmann and St. Gobain have important interests: the Kuhlmann group also makes rayon, pharmaceutical products, synthetic resins, glues, plastic substances, and so forth. The bulk of the superphosphates and fertilisers generally are produced by the Kuhlmann and St. Gobain groups in their own or affiliated widely scattered factories. Perfumes are made principally by half a dozen firms: pharmaceutical and other fine chemicals, notably for photographic and laboratory uses, by the Usines du Rhône-Poulenc amalgamated company. The chief maker of disinfectants has fifty or sixty factories in France. The bulk of the soaps manufacture, which is carried on principally in Marseilles (hard soaps), Lille (soft) and Paris (perfumed), is in few hands.

The Kuhlmann Company

The Kuhlmann company, which since 1930 has the largest capital (320 millions) of any chemical concern, possessed in 1914 with a capital of 6 million francs five medium works in or near Lille and one at Amiens, all occupied in making sulphuric and nitric acids, chloride of lime, superphosphates and other heavy chemicals. It became possessed of other works during the war when five of its own were in enemy hands, and raised its capital eighteen times before its present figure was reached. It now operates directly nineteen works. Its products include industrial chemicals (acids, oleum, sulphates, sodas, chromium salts, chlorine, etc.) agricultural chemicals (phosphatic, nitrogenous, phospho-nitrogenous, superphosphates, insecticides, etc.) and organic products (dyestuffs, glues, plastic materials, paints, varnishes, synthetic resins, pharmaceutical products, etc.). At its Villers St. Paul (near Freil) works, covering over 100 acres, and three other works are produced dyestuffs, plastic materials, etc.: it has interests in the St. Denis dyestuffs company (capital 50 millions). It has formed three companies with three leading collieries (Courrières, Anzin, Marles) for tar products and by-products.

In 1930 the Kuhlmann company absorbed the Compagnie Bordelaise de Produits chimiques (capital then 70 millions, but reduced to 35 millions in December, 1932), whose four superphosphate works had a total capacity of 370,000 tons. In 1929 it had secured interests in the Ugine electro-chemical and electro-metallurgical company (capital 122 millions, with ten hydro-electric power works in the Alps and elsewhere, and with various works for metallic carbides, electric steels, etc.). In 1932, it secured control of the Société Aubry (capital 55 millions) with three works for the manufacture of compound fertilisers, explosives and other products.

With its affiliated concerns, the Kuhlmann company has likewise expanded production capacity since 1928. It has created sulphuric acid plants at Dieuze in Lorraine, and at Port de Bouc near Marseilles: a lithopone plant or section at Dieuze, for the production of their affiliated Société de Produits Barytiques: a carbon bisulphide plant at Wattrelos, near Roubaix, and at L'Estaque, near Marseilles, for that

of its affiliated Société Progil-Kuhlmann: a nitric acid plant (Fauser method) with a daily capacity of 350 tons at the Lille-lez-Madeleine works: a formaldehyde plant at their great and very modern works of Villers St. Paul, near Creil, where the dyestuffs and the plastic materials capacity have actively developed in recent years.

The St. Gobain Company

The St. Gobain company, whose capital of 60 millions in 1919 has been progressively increased to its present figure of 310 millions, the last increase in 1930 having been from 225 millions (in 1928), produces on a large scale all industrial and agricultural chemicals and is the largest producer of plate-glass and other glasses in France. It owns 25 or 26 chemical works, four glassworks, a salt mine in Lorraine, a pyrites mine in the Lyons area, and a phosphate mine in Tunis: in 1931 and 1932 it had participations in 158 and in 153 other undertakings. Its most remarkable single participation is that in the new oil refinery on the Etang de Berre, near Marseilles: its investment therein appears to represent 122 millions, or over half the capital, and (in 1932) its guarantees amounted to 207 millions. Like Kuhlmann, St. Gobain has close relations with the coal mining industry for chemical purposes; and among its participations is that in the Air Liquide (24 works, capital 88 millions) a leading producer of synthetic ammonia, oxygen, hydrogen, etc., which in 1931, absorbed Ammonia Synthétique, and has long been connected with La Grande Paroisse (capital 60 millions), which it also works with colliery companies.

The company does not appear to manufacture itself the finer chemicals, which is no doubt undertaken by some of the 153 affiliated companies. It has built a new sulphuric acid plant at La Bassée, near Lille; in conjunction with the Produits Chimiques de Roche-la-Molière, a factory at St. Fons for nitric acid production. In 1932, it opened a new works at Rouen for synthetic fertilisers with ammonia basis; in 1933, with the Société Grande Paroisse, a synthetic nitrate of soda works at Chauny.

Nitrogenous Fertilisers

The consumption of fertilisers has made much headway in France since 1913, potash having risen from 33,000 to 190,000 tons, phosphatic from 394,000 to 530,000, and nitrogenous from 63,000 to 145,000 tons: in the last three years, agricultural depression has tended to check progress. France harbours no misgivings concerning the requisite native supplies of potash and of phosphatic fertilisers, but she has seriously been exercised by the problem of nitrates, both from the point of view of national defence and of agricultural requirements. Her coke ovens and gasworks produce sulphate of ammonia, but not in adequate quantities: her synthetic ammonia output is likewise inadequate, and she is handicapped in relation to the chief European producers (Germany, Great Britain and Norway) by her inferior coal or water-power resources, and by certain capital charges (especially in relation to Germany—the chief producer—whose overhead charges had been largely reduced through various circumstances). In 1931, a leader in the French chemical industry wrote that the cost of French coal is so much more than that both of the German lignite and of the Norwegian electric energy, that it makes the cost of the French synthetic ammonia fertilisers about one-third dearer than the German or Norwegian.

France did not take part in the Anglo-German-Norwegian-Chilean conference of 1929, which agreed upon reduction of output, unification of prices, and common propaganda. The French chemical industry took part, however, in the European conference in 1930, which resulted, by an agreement for one year, in the reservation of the national markets to national production, the fixation of a scheme of reduction of national output, the institution of a central office to safeguard prices levels and of a central clearing house for compensating the limitations upon output in certain cases, the common participation in propaganda and in research. This agreement was not renewed in 1931: at the conference summoned for its consideration, the production capacity of France was estimated at 153,000 tons of nitrogen (71,950 by the Claude, 46,700 by the Casale, 18,250 by the Mont-Cenis and 16,100 by the N.E.C. processes). The present capacity is estimated at 70,000 to 80,000 tons.

In 1931, in view of this failure to reach agreement, of the general over-production of ammonium sulphate and of synthetic ammonia, which caused prices to fall heavily, the internal production was regulated by agreement between producers, of which the State is one. The State reserved the right to sell a minimum of 80,000 tons a year: certain private concerns, notably Anzin-Kuhlmann and Marles-Kuhlmann (the latter in the year 1931-32 produced 9,891 tons of synthetic ammonia and 20,335 tons of ammonium sulphate) had their output limited. The State then subjected to import licences the imports of ammonia, cyanamide and nitrates of soda and lime; and a little later restricted imports of all other nitrogenous fertilisers such as potassium nitrates, phosphates and nitrate of ammonia. The first import licence was granted only at the end of 1931, after negotiations between the German Stikstoff Syndicate and the Comptoir Français de l'Azote, the selling organisation of the French nitrogen producers: it would appear that Germany was to be allowed to import 150,000 tons of soda nitrates, the importers to sell at 95 francs a 100 kg. and to pay the Comptoir 12 francs per 100 kg. Licences were subsequently accorded to the United States and other countries under analogous conditions.

National Organisations

In 1927 was created at Paris the Federation of the Chemical Industries (now called Union des Industries Chimiques) for the purpose of providing a strong national organisation to serve as a connecting link between the manufacturing units and separate groups for general representation objects, general policy, and researches or other matters of common interest. In 1932 were affiliated twenty-nine of the central trade associations for the separate chemical branches; they included those for gas and by-products of gas and tar distillation, wood distillation, glues and gelatine, dyestuffs, tanning extracts and dyes, explosives, fertilisers and superphosphates, carbonic acid, lithopone and zinc white, synthetic products of organic chemistry, drugs and pharmaceutical products, photography, cinematographic films, paints, varnishes, petrol, stearine and soaps, and so forth.

Designed to be the centre of the International Pure and Applied Electricity Union, as well as the headquarters and clearing house for all chemical documentation, the International Chemistry Office was founded in Paris in 1927 as the result of an international conference summoned by the French Government. By January, 1931, a total of 25 million francs had been subscribed towards its realisation: and in 1932, the required number of ratifications of the convention creating the office having been received, its activities commenced. The building in the centre of Paris destined to be its headquarters was nearly completed early in 1934.

The Bozel Company, originally of Bozel in the Savoy, which had in 1921 a capital of six millions, gradually absorbed various concerns, including the *Etablissements Malétra* in 1925, when its capital was brought to 30 millions; subsequent increases occurred till the capital reached its present figure of 100 millions. It now operates 14 works. Near Bozel, it has two hydro-electric power works and mines, and makes calcium carbide, acetic aldehyde, ferro-alloys, etc.; it has other hydro-electric works in Savoy making similar products, also near the Mediterranean at Plan du Var. Other works are: two near Paris, three in the Seine-Inférieure (near Rouen, etc.) one at Rennes and so forth. Its chief products are heavy chemicals, soda, carbonate of soda and potash, liquid chlorine, oleum, nitric acids, sulphate of ammonia, fertilisers, etc. It owns salt mines in Algeria, cobalt and chrome concessions in New Caledonia, large industrial property (125 acres) near the new petrol refining port of St. Jerome on the Seine. Its participations are numerous; in water power, glue, rayon, plastic materials, and other works.

THE sugar factory in Mandya in the Mysore territory which the Mysore Government has promoted is now nearing completion. The factory is built on a large scale, and scope for further extension at a minimum expense is allowed. The imports of sugar from outside India into Madras ports during the past year were approximately 50,000 tons. Sugar is also coming into South Indian markets from North India, but it should be possible to produce sugar in Mysore than in the majority of North Indian factories.

Construction and Maintenance of Roads with Tar in Great Britain.

By W. E. CONE, Technical Adviser, British Road Tar Association

IN a paper presented to the plenary session of the International Road Tar Conference, at Munich, on September 5, Mr. W. E. Cone, technical adviser to the British Road Tar Association, said that roads differ from each other very much in texture, and since the nature of the surfaces presented for treatment has an important bearing on the procedure to be adopted in carrying out the work, it is essential that the characteristics of any particular type of road should be carefully studied, so as to determine the most effective form of treatment. The road should present a regular and uniform surface, and pot-holes and other irregularities should be patched and made good with tarred aggregate. The surface should be swept clean of all dust, dirt and other foreign matter, particular care being taken to clean the edges of the road in order to ensure satisfactory treatment over the whole width of the surface. For roads carrying light and medium traffic the tar should generally fall within the requirements of British Standard Specification for Tar No. 1, and for heavy traffic Tar No. 2 should be used. In each case the viscosities should be varied in accordance with the seasonal conditions. The rate of spread of the tar will vary in accordance with the nature of the surfaces presented for treatment, and this can best be determined in line with actual conditions. The necessity for a thermometer to control the temperature of the tar is not always appreciated, but it is a very necessary part of the equipment in surface dressing work. Without this simple instrument, it is a matter of speculation as to whether the tar has been overheated, and as this adversely affects its physical properties, all doubt would be removed by using a thermometer. The tar is generally applied at a temperature between 220° F. and 260° F. Every care should be taken to prevent the entry of water into the tar boiler, as, if this takes place, it will cause frothing and the tar is liable to boil over.

Gritting Operations

Great importance attaches to the gritting operations, for on the establishment of intimate contact between the stone and the tar depends the safety of the surface. The selected gritting material should possess the requisite physical properties to withstand fracture and crushing under the impact of traffic, and should preferably be of a light colour. It cannot be over-emphasised that damp or wet chippings will not be as efficiently held by the dressing as would be the case if they were dry. The presence of moisture and dust has a retarding influence on the wetting action between the stone and the tar, and every precaution should be taken to see that only clean dry chippings are used.

With present-day qualities of road tar, there need be no hesitation in extending its use for main roads carrying heavy traffic, as is already the case on a large mileage of roads in Great Britain. Effective control of the variables is the secret of success in the surface treatment of roads with tar, which, summarised, are:—(1) Nature and preparation of the surface to be treated; (2) selection of the tar for roads carrying light, medium and heavy traffic; (3) control of the rate of spread and temperature at which the tar is applied; (4) nature, gauge, rate of spread and the dryness or wetness of the gritting material; (5) importance of rolling, and (6) climatic conditions under which the work is carried out, and the dryness or wetness of the road surface. With a correct understanding of the "cause and effect" of these variables, a safe durable surface is assured.

Tarmacadam has won a deservedly high reputation in Great Britain. The technique of this form of construction has not advanced to the extent it might have done. So simple have the operations of its manufacture and laying become, that in many cases there is an entire disregard of the factors which may adversely influence the results to be obtained from its use. There are a number of variables requiring special attention in the manufacture of tarmacadam, which, summarised, are:—(1) Nature and physical properties of the mineral aggregate; (2) careful grading of the aggregate; (3) selection of the tar for any particular type of aggregate;

(4) determination of the amount of tar for any given mixture of aggregate; (5) control of the temperature to which the aggregate is heated, and (6) control of the temperature to which the tar is heated. The material should only be prepared in well designed plants, embodying the latest devices, covering each stage of the operations. Such progress that has been brought about reflects great credit on those firms in Great Britain who have installed modern plant and equipment, and who are producing tarmacadam under scientifically controlled conditions.

Semi-Hot and Hot Processes

There remains to be considered semi-hot and hot process tarmacadam (tar concrete). The advantages to be derived by laying the mixture in the heated state are principally concerned with the binder and the consolidation of the material. In the first place it enables a tar of improved physical properties to be used. Secondly, the mixture possesses a higher degree of plasticity at the time of rolling, which ensures the maximum amount of consolidation taking place. Hot-mix materials are eminently suitable for roads carrying heavy traffic, and should preferably be laid as single-coat work to a consolidated thickness of 2 to 3 in. The grading of the aggregate should be carefully controlled, since it is desirable to have a dense compressed mixture to withstand the heavier loads. The mixture should be designed in a manner to secure a properly balanced mineral aggregate, incorporating a small percentage of mineral filler. The particle sizes of the aggregate and percentage proportions in which they should be present in the mixture, will largely be determined by the consolidated thickness to which it is laid. For this class of work, the tar should generally fall within the requirements of British Standard Specification for Tar No. 3, or a tar of even higher consistency can be used. The temperature to which the binder should be heated will largely depend on the climatic conditions, and the distance the material has to be transported. It will be found in practice that a temperature between 220° F. and 260° F. for the aggregate and binder will generally meet the required conditions. After the aggregate has been thoroughly coated with the binder, the mixture should be hauled to the road and protected if necessary against weather conditions. It should be used as soon as it is delivered on to the road, and should be carefully and evenly spread in one layer while hot upon the prepared foundation to provide the specified thickness after compaction by rolling. The rolling should be carried out as soon and as quickly as possible, using a roller between 8 to 10 tons, loaded. Rolling should be continued until all roller marks disappear, and the surface gives indications of no further compressibility.

United States Arsenic Industry

Advance Statistics for 1933

THE production of arsenious oxide (white arsenic) in the United States dropped in 1933 to 10,650 short tons—the smallest quantity since 1926. Approximately two-thirds (7,181 tons) was refined; the remainder (3,469 tons) was crude. Sales of refined and crude arsenic amounted to 11,797 tons valued at \$636,132. Approximately 75 per cent. (8,768 tons) was sold as refined white arsenic, for \$489,549, and the remainder (3,029 tons) was sold as crude arsenic, for \$146,583.

In 1933, imports of white arsenic rose to 10,583 short tons valued at \$512,542, the highest figure since 1929; in 1932, only 6,882 short tons valued at \$357,091 were imported. Imports from Mexico which formerly furnished the bulk of the foreign arsenic used in the United States showed a gain of a few hundred pounds (4,040 short tons valued at \$256,511 in 1933, compared with 3,325 short tons valued at \$182,671 in 1932). The greater part of the increase resulted from a sudden influx of shipments from France. Imports of white arsenic from that country rose to 3,810 short tons valued at \$113,606.

Nickel Bronzes

Some Applications in the Chemical Industry

THE advantages to be gained by the addition of small percentages of nickel to bronze alloys are now well known, and manufacturers of bronzes for industrial purposes frequently include a small proportion of nickel in these alloys.

Perhaps the most marked influence of nickel additions is the effect on the elastic properties of bronzes, followed closely by the resulting increase in resistance to shock. Apart, however, from their effect on mechanical properties, the nickel additions exert considerable improvements on the physical properties of bronzes. For example, it has been clearly demonstrated that even as small a quantity as 0.5 per cent. of nickel is sufficient to produce a refinement of the grain. The optimum addition, of course, varies with the actual composition of the alloy and the design of castings to be made, but generally is not more than 2 per cent. Coincident with this refining of the grain occurs what might be termed

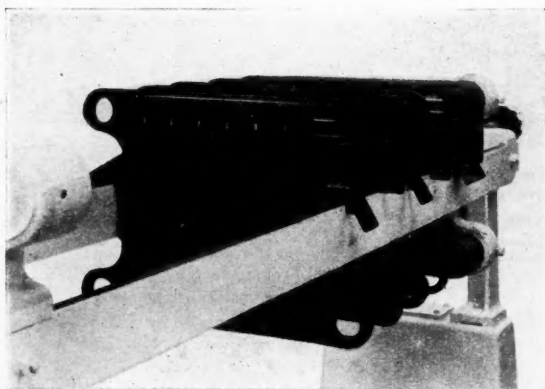


Fig. 3. The grooved plates of this heat exchanger are made of nickel bronze in order to overcome foundry difficulties.

a "densifying" action. It is common knowledge that bronzes are prone to develop minute cracks which only become apparent under the microscope. The densifying action of nickel is attributed to its tendency to minimise the formation of such cracks and thereby constitutes a valuable aid to the obtaining of pressure tight castings.

Another important effect of nickel, and one which has long been recognised, is its tendency to inhibit lead segregation in lead bronze alloys. This feature is illustrated in the accompanying photomicrographs, which show the structures of a lead bronze containing no nickel (Fig. 1) and of a similar alloy in which 2 per cent. of the copper has been replaced by nickel (Fig. 2). A comparison of the two structures clearly indicates the finer grain and more even distribution of lead in the latter alloy.

A practical example of the use of nickel to obtain soundness and grain refinement in bronzes occurs in connection with the heat exchangers manufactured by the Aluminium Plant and Vessel Co., Ltd. These machines, which are used

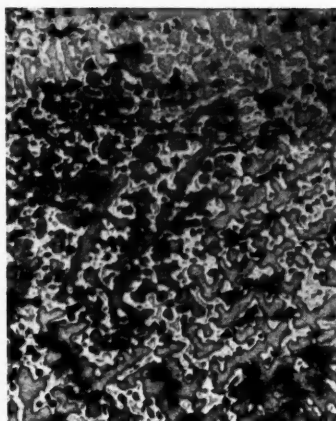


Fig. 1.

These photomicrographs show the change in structure of a lead bronze (Fig. 1), brought about by the addition of nickel (Fig. 2).



Fig. 2.

in the liquid foodstuffs and chemical industries for handling milk, cream, sugar solutions, wort, vinegar, beer, etc., consist of a number of plates having interconnected vertical grooves on each side, separated by, and in close contact with, thin plain sheets which convert the grooves into the equivalent of one continuous pipe. The two liquids between which heat is to be exchanged, flow up and down the grooves on opposite sides of the plates, the latter being mounted as shown (Fig. 3) and pressed tightly together by means of a travelling end plate as in a filter press. The grooved plates, which are only $\frac{1}{8}$ in. thick in the grooves, are hydraulically tested to 30 lb. pressure. The addition of $\frac{1}{2}$ per cent. of nickel to the bronze used for this purpose greatly minimises foundry difficulties and increases the soundness of the castings.

Further examples of the use of nickel in bronze castings by the same firm include tube plates for condensers for

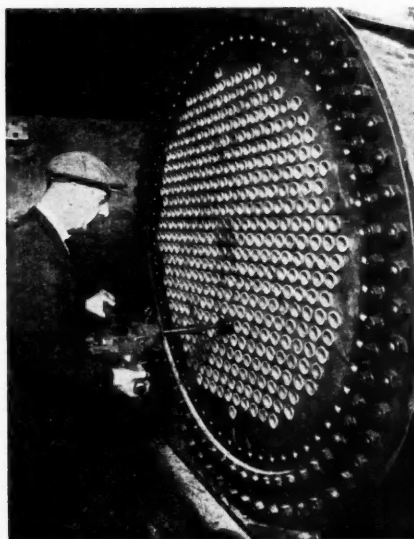


Fig. 4. The tube plate of this condenser is made of special bronze containing lead and nickel.

chemical work (Fig. 4), made in an alloy containing 7 per cent. of lead with 1 per cent. of nickel to prevent segregation of the lead, and a large pressure vessel 4 ft. 6 in. in diameter and 10,000 lb. in weight, of 88-10-2 composition to which $\frac{1}{2}$ per cent. of nickel was added.

Fire at Magnesium Works

Foundry and Machinery Destroyed

A FIRE occurred on Wednesday at the works of Magnesium Castings and Products, Ltd., Point Pleasant, Wandsworth. Adjoining the blazing building were a petrol depot, a timber yard, and a moulding factory, and there were several truck-loads of oil on a railway siding. The fire began in the foundry, a long steel and corrugated iron shed in which were 10 small furnaces, three tilting furnaces, a crane, two fans, and two electric motors, all of which were destroyed within a few minutes. Tons of magnesium in drums were pulled out by workmen, but the heat set them alight.

A district call was circulated by the fire brigade, and an hour after the outbreak began additional firemen were stationed at all the adjoining buildings to check the fire in case sparks should set light to them. Within 10 yards of the blazing building were the main stores and offices where many tons of magnesium and other inflammable material are kept. A tank containing 250 gal. of fuel oil exploded in one end of the shed. The firemen ran out hundreds of feet of hose as soon as they arrived, but were unable to use them. They had to watch the fire burn itself out before they could try to damp it down with sand, and for hours afterwards they were demolishing the derelict building and carrying earth in wheel-barrows from a dump to throw on the smouldering ruins. Between 20 and 30 tons of magnesium were burned in the shed.

Chelsea School of Metallurgy

Details of Special Courses

THE Chelsea Polytechnic School of Metallurgy, Manresa Road, London, S.W.3, has issued its prospectus for the session 1934-35, together with leaflets giving particulars of a course of engineering metallurgy and two courses in industrial metallurgy. The school comprises a metallurgical lecture room, furnace room and dry assay laboratory, heat-treatment and physical testing laboratory, microphotographical studio and dark room, research and wet analysis laboratory, and a metal workshop. The equipment includes, in addition to adequate facilities for general metallurgical work, an excellent heat treatment plant, thermal analysis apparatus, and an extensive metallographic outfit. The layout of the heat treatment shop (which includes welding plants, plating set, and a complete furnace equipment) is especially designed for practical industrial instruction and research. A list of the various courses existing both in the day and evening college is given in the prospectus.

Certain scholarships and exhibitions granted by local education authorities are tenable at the Polytechnic. The "Mrs. John Ross" Scholarship, consisting of a free place, value £21, in the day college and a maintenance grant, is open to youths who are resident and who have lived in Fulham for at least six months previously. Awards are made annually to students of special merit. Bursaries in metallurgy are awarded by the Armourers and Braziers Company for which students are eligible. In addition to providing for the academic study of metallurgy, the courses are designed to meet the requirements of industrial students. Some of the special courses are run in collaboration with local firms. Other features of the instruction available are demonstrations by interested firms, films and lectures by experts, visits to works and discussions held at the termination of advanced lectures.

The course in engineering metallurgy is a two-year course arranged, primarily, for those studying for the examinations of the engineering institutions and other professional associations. It is also suitable for technical representatives of chemical and chemical-engineering firms and those engaged in a productive, administrative, or consultative capacity in all branches of engineering. The course consists of lectures with demonstrations, discussions, films and occasional lectures by specialists, together with practical work. The course is recognised by the Institution of Gas Engineers, and is suitable for students taking the examinations of the Institution of Mechanical Engineers. A Polytechnic Course Certificate will

be awarded to students who satisfactorily complete the course. The session begins on September 24; enrolments on September 20 and 21, 6—9 p.m., or by letter or personal application up to and including October 1.

The first course in industrial metallurgy is a junior course for those apprenticed or employed as engineers, brass finishers, toolmakers, moulders, welders and allied trades. The course extends over two years. Each session's work (October-April) consists of 24 lectures and demonstrations followed by practical work in metal workshops and heat treatment laboratory. A Polytechnic Course Certificate will be awarded to students who satisfactorily complete the course.

The second course in industrial metallurgy is a senior course for technical representatives and salesmen in engineering firms, those engaged in the ironmongery and brass industry, and all interested, in a productive and administrative capacity, in the production and sale of metallic goods. The course consists of 24 lectures, with demonstrations and discussions. Occasional lectures are given by specialists and industrial films are shown. A Polytechnic Course Certificate will be awarded to students who satisfactorily complete the course.

How to Deal with Bugs

Use of Hydrocyanic Acid Gas

THE use of hydrocyanic acid gas against the bug was discussed by Mr. J. Higginbotham, chief sanitary inspector, Manchester, at the annual conference of the Sanitary Inspectors' Association at Southport on Wednesday. Mr. Higginbotham said that the gas was the most toxic known, and that the greatest care would have to be exercised in its use.

Sir Leonard Hill said that it was not quite correct to say that hydrocyanic acid gas was the most toxic gas known. It was extremely toxic under certain concentration. In war they had gases which were toxic one in a million, and therefore more deadly. Hydrocyanic acid gas was rejected by us as a war gas. The French wanted to use it. They experimented with it on dogs, but on monkeys and men it was found not to be so toxic as it was in the case of dogs. All doubts as to this were settled by a great scientist, who went into a sealed chamber and breathed in the gas at a concentration which had been found toxic for dogs. It did not prove toxic on the scientist. That was only one of the very brave acts by men of science, who frequently risked their lives and sometimes sacrificed them in the cause of research.

Mr. Higginbotham said he thought that the gas attack on vermin would be a war of the experts. Sanitary inspectors were too busily occupied to embark upon disinfection by hydrocyanic acid gas owing to the exacting nature of the work and the minute attention to details involved in using a gas of such penetrative power and lethal effects. They should not embark on this form of warfare without employing competent people to apply the gas, people who had no other interests to distract them from the serious nature of their work. "Our experience in dealing with bugs is that hydrocyanic acid gas is efficient, and can safely be applied when the requisite precautions are taken," he said.

Mr. J. C. Dawes, of the Ministry of Health, said that the cost of the public cleansing service in 1931 and 1932 was £10,500,000. The amount of "dry" refuse produced per annum was about 10½ million tons.

Italian Dye Industry Developments

CONSUMPTION of synthetic organic colours in Italy has reached a value of 140,000,000 lire, according to the annual report of the "Montecatini" company. Of this, 65,000,000 lire represents the Italian production and 75,000,000 the imports. The value of the Italian production also includes that of the production of groups controlled by foreign capital (over 15,000,000 lire). The agreements with the International Dye Cartel expired on December 31, 1933. The belief is expressed in the report that new agreements may be reached in the mutual interest of the parties concerned. The company has started the building of a vast laboratory at Cesano, for organic chemistry, in order to facilitate the preparation of capable Italian technicians for work in this field.

Continental Chemical Notes

BISMUTH DEPOSITS in the Spanish province of Cordova are to be exploited with the aid of English capital.

A POLISH MEMBER OF THE SOLVAY GROUP has commenced the manufacture of phosphate fertiliser (16 to 28 per cent. phosphoric acid) by the fusion process and is marketing the products under the name of "Extraphosphanat."

A LEADING DANISH PAINT AND VARNISH FIRM (Sadolin & Holmblad) has launched a subsidiary undertaking (Koge Chemical Works) which will produce aniline dyestuffs, chrome tanning agents, synthetic perfumes, shoe creams, etc.

CALCIUM CHLORIDE SOLUTION is being tested out as a dust-binding dressing on Finnish roads. A total length of 1,500 kilometres was successfully treated at the beginning of June, the costs working out at about 1 Finnish mark per square metre of roadway.

ONE OF THE GERMAN COMPANIES operating a wood saccharification process (Holzverzuckerung und Chem. Fabrik Tornesch) reports a loss of 273,000 marks for 1933 on the share capital of 1 million marks. This is explained to be the result of extraordinary expenditures, the factory plant being completely overhauled and rebuilt between January and May, 1933, during which period regular output could not be maintained. A programme of experimental work is now being carried out.

CANE SUGAR CAN BE UTILISED as a source of ethoxy methyl furfural and methyl levulinate—both of potential interest as solvents—by a process described in detail by Weidenhagen and Koroskyi in "Ztschr. Zuckerindustrie," 1934, page 470. The raw material is heated with dilute alcoholic hydrochloric acid for 4 to 7 hours at about 100° C. A yield of 49 per cent. is attainable when starting from cane sugar, as well as from fructose and inulin. Carbohydrates of higher molecular complexity such as starch are also amenable to the process but only give yields of about 25 per cent. maximum. Using acid of 0.25 per cent. concentration, the crude reaction product consists mainly of the furfural derivative, while the methyl levulinate preponderates when working with higher acid concentrations.

A METHOD OF ISOLATING PURE NICOTINE solution in high concentration (50 to 80 per cent.) from waste tobacco has been developed at the University of Bucharest by R. Hofmann, who utilises a novel adsorptive agent in the shape of the carbonised tobacco plants themselves. In contrast to pure active carbon which catalytically decomposes part of the nicotine at 100° C.—to which temperature the mass is exposed during extraction by steam distillation—and thus leads to a lower grade product, tobacco plant carbon is free from this drawback presumably owing to the presence of about 20 per cent. of silica. This type of prepared carbon adsorbs 3 to 5 per cent. of its weight of nicotine. The inventor claims that his method now opens up for the first time the prospect of utilising tobacco waste for high quality insecticides. A special apparatus for working the process is described. (German Pat. 593,259.)

IN A LONG SURVEY OF THE PLANS which have been adopted or are contemplated with a view to placing the Russian paint industry on a sound footing, the "Chemische Industrie," September 1, reports that the shortage of solvents may be met with the aid of by-products of the synthetic rubber industry, which is capable of supplying butyl alcohol, ethyl acetate and chlorinated solvents. To cope with the shortage of vegetable drying oils, recourse is to be made to petroleum products. Plans are also under consideration for expanding the production of casein and silicate paints. Efforts are also being made to establish a titanium white industry on the basis of the titanium-magnetite deposits in the Ural Mountains. A factory is to be erected which will produce 12,000 tons of titanium dioxide per annum at the outset, which will be increased 30 to 35 thousand tons subsequently. The lithopone factory at Woroski, with an annual output of 18,000 tons, is to be completely rebuilt.

FOREIGN FIRMS ARE NO LONGER AUTHORISED to tender for Spanish Government supplies of the following products: Tuluol, formaldehyde, terpenes, ether and acetyl salicylic acid.

TWO LARGE-SCALE EXPERIMENTAL PLANTS for coal hydrogenation to benzene, utilising two distinct processes, are being erected in France under official auspices. Both plants are located in the Pas-de-Calais mining area. The French Government owns a direct interest in the one process which is sponsored by the Soc. Nationale de Recherche, while the second process is the property of Mines de Béthune. The capital costs for the processes mentioned are 45 million and 38 million francs respectively, the whole of which will be supplied by the State in each case.

Chemical Education in Yorkshire

Specialised Courses in Advanced Chemistry

IN April, 1933, the Yorkshire Council for Further Education appointed a committee to prepare a scheme of specialised courses in chemistry of an advanced character, to be held in the technical colleges in the Bradford-Huddersfield-Leeds area. The scheme proposed has now been approved and will be provided by the local education authorities concerned at the Bradford, Huddersfield, and Leeds Technical Colleges in the session 1934-35.

A pamphlet issued by the Council stresses the fundamental importance of strict chemical supervision in our major industries, not merely in the basic chemical industries themselves, but in other branches in which Yorkshire is pre-eminent, such as textiles, engineering, mining, and metallurgy. The knowledge, experience, and skill of trained chemists will play an important part in the gradual recovery of our industrial supremacy. The country in general and Yorkshire in particular cannot afford to fall behind the standard set by other countries in the utilisation of chemical talent, both in controlling and improving existing processes and in devising new ones. Owing, however, to the wide curriculum now necessarily covered in the training of chemists, one serious difficulty is found, not only by senior students and young graduates of technical colleges and universities, but also by experienced chemists already engaged in industry, namely, that of keeping abreast of the latest developments in the theory and technique of special branches of the subject.

It has been long felt that there is a definite need for suitable short specialised "refresher" courses to be given by experts in convenient centres. Such courses are intended primarily for chemists who already possess qualifications equivalent to a university degree, the Associateship of the Institute of Chemistry, the Higher National Certificate in Chemistry or Final Certificates of the City and Guilds of London Institute. It is hoped that the courses will help to meet a real need. In 1935-36 and subsequent years it is intended to carry the scheme further. New courses will be advertised and some of those given this year will be repeated, under a rota system, at a different centre. Full details of the courses are set out in the pamphlet, copies of which may be obtained from any of the constituent societies or from the secretary of the Yorkshire Council for Further Education, Calverley Street, Leeds.

There are a number of other lectures of an advanced character forming part of existing courses at technical colleges which, although not of quite the same highly specialised type, are valuable to students who have reached a standard equivalent to that of the Higher National Certificate and may be working for a degree of the University of London or the Associateship of the Institute of Chemistry and may wish to study in further detail some branch of chemistry in which they have not hitherto had time to specialise. Thus, the student who has specialised in organic chemistry generally may wish to attend lectures upon colouring matters or upon physical chemistry; the graduate may wish to attend a course upon oils and fats, upon textile analysis or upon introductory chemical engineering. Particulars of these courses are therefore included in the pamphlet.

Weekly Prices of British Chemical Products

Review of Current Market Conditions

CHEMICAL markets are recovering from the effects of the holiday season, and business generally has been on a somewhat better scale during the week. There has been little variation in prices. Activity in the industrial chemical section has been centred chiefly

in acetic acid, acetone, formaldehyde, formic acid and oxalic acid. There is a fair demand for sal ammoniac, but competition is keen, and the competition for business in formaldehyde is preventing an improvement in values. A fair amount of interest is now being shown in most potassium compounds and supplies of potassium chlorate are becoming scarce. The arsenic, copper sulphate and sodium sulphide markets are dull. In the wood distillation products section good orders have been passing for all materials except wood creosote and wood tar. Stocks of charcoal and methyl acetone are low. The coal tar products

market is fairly steady and prices show little change. There is quite a good demand for cresylic acid, creosote oil and refined naphthalene. The solvent naphtha market is dull and there is not much business in coal tar pitch. Business in pharmaceutical products is still rather limited, but there is a little more inquiry for aspirin and bromides, and benzoic acid, citric acid, sodium benzoate and tartaric acid are fairly active. Price changes of interest are increased rates for quinine sulphate, Rochelle salt and

seidlitz powder, and a reduction in the case of phenacetin. The general tone of the essential oils market is quiet.

LONDON.—Prices remain very steady with quite a fair demand. There is no change to report in the coal tar products market, and prices remain the same as last week.

MANCHESTER.—Although perhaps less in evidence than during the greater part of last month there are still indications of holiday influence upon trade, and on the Manchester chemical market during the past week most reports have referred to relatively dull conditions. On the whole, however, traders are still disposed to take a reasonably cheerful view of the autumn outlook, apart, perhaps, from the textile and allied industries, where the likelihood of any early material expansion in the demand for chemical products seems to be rather remote. Contract buying of most

classes of materials this week has been slow, although the tendency is for delivery specifications to cover somewhat larger quantities than has been the case during the previous four or five weeks. The price position generally, so far as the leading chemical products are concerned, continues steady. Among the by-products, however, the tendency is easy in carbolic acid.

SCOTLAND.—Business in the Scottish heavy chemical market is showing a steady upward tendency.

Price Changes.

Wood Distillation Products.—CHARCOAL, £6 5s. to £10 per ton; WOOD NAPHTHA, MISCELL, 2s. 9d. to 3s. 3d. per gal.; WOOD TAR, £2 to £4 per ton.

Pharmaceutical and Fine Chemicals.—PHENACETIN 3s. to 3s. 6d. per lb.; QUININE SULPHATE, 2s. 1d. per oz.; SEIDLITZ POWDER (pulv.), 58s. 9d. to 62s. 6d. per cwt.; SOD. POTASS. TARTRATE (Rochelle salt), 70s. per cwt. for 1-ton lots.

Manchester.—CARBOLIC ACID, CRYSTALS, 7d. to 7½d. per lb.; crude, 1s. 9d. per gal.

All other prices remain unchanged.

General Chemicals

ACETONE.—LONDON: £65 to £68 per ton; SCOTLAND: £66 to £68 ex wharf, according to quantity.

ACID, ACETIC.—Tech., 80%, £38 5s. to £40 5s.; pure 80%, £39 5s.; tech., 40%, £20 5s. to £21 15s.; tech., 60%, £28 10s. to £30 10s. LONDON: Tech., 80%, £38 5s. to £40 5s.; pure 80%, £39 5s. to £41 5s.; tech., 40%, £20 5s. to £22 5s.; tech., 60%, £29 5s. to £31 5s. SCOTLAND: Glacial 98/100%, £48 to £52; pure 80%, £39 5s.; tech., 80%, £38 5s. d/d buyers' premises Great Britain. MANCHESTER: 80%, commercial, £39; tech. glacial, £52.

ACID, BORIC.—Commercial granulated, £25 10s. per ton; crystal, £26 10s.; powdered, £27 10s.; extra finely powdered, £29 10s. packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots.

ACID, CHROMIC.—10½d. per lb., less 2½%, d/d U.K.

ACID, CITRIC.—9d. per lb. less 5%.

ACID, CRESYLIC.—97/99%, 1s. 8d. to 1s. 9d. per gal.; 98/100%, 2s. to 2s. 2d.

ACID, FORMIC.—LONDON: £43 10s. per ton.

ACID, HYDROCHLORIC.—Spot, 4s. to 6s. carboy d/d according to purity, strength and locality. SCOTLAND: Arsenical quality, 4s.; dearsenicated, 5s. ex works, full wagon loads.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £48; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £53; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works, according to district and quality. SCOTLAND: 80°, £23 ex station full truck loads.

ACID, OXALIC.—LONDON: £47 17s. 6d. to £57 10s. per ton, according to packages and position. SCOTLAND: 98/100%, £48 to £50 ex store. MANCHESTER: £49 to £53 ex store.

ACID, SULPHURIC.—SCOTLAND: 144° quality, £3 12s. 6d.; 168°, £7; dearsenicated, 20s. per ton extra.

ACID, TARTARIC.—LONDON: 1s. per lb. SCOTLAND: B.P. crystals, 1½d., carriage paid. MANCHESTER: 1s. 0½d.

ALUM.—SCOTLAND: Lump potash, £8 10s. per ton ex store. ALUMINA SULPHATE.—LONDON: £7 10s. to £8 per ton. SCOTLAND: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM BICARBONATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE. SCOTLAND: Lump, £30 per ton; powdered, £33, in 5-cwt. casks d/d buyers' premises U.K.

AMMONIUM CHLORIDE.—£37 to £45 per ton, carriage paid. LONDON: Fine white crystals, £18 to £19. (See also Sal ammoniac.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Sal ammoniac.)

ANTIMONY OXIDE.—SCOTLAND: Spot, £26 per ton, c.i.f. U.K. ports.

ANTIMONY SULPHIDE.—Golden 6½d. to 1s. 1½d. per lb.; crimson, 1s. 3d. to 1s. 5d. per lb., according to quality.

ARSENIC.—LONDON: £16 10s. c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £23 ex wharf. MANCHESTER: White powdered Cornish, £20 10s. to £21 ex store.

ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.

BARIUM CHLORIDE.—£11 per ton. SCOTLAND: £10 10s.

BARYTES.—£6 10s. to £8 per ton.

BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.

BLEACHING POWDER.—Spot, 35/37%, £7 19s. per ton d/d station in casks, special terms for contract. SCOTLAND: £8 in 5/6 cwt. casks for contracts over 1934/1935.

BORAX, COMMERCIAL.—Granulated, £14 10s. per ton; crystal, £15 10s.; powdered, £16; finely powdered, £17; packed in 1-cwt. bags, carriage paid home to buyer's premises within the United Kingdom in 1-ton lots.

CADMIUM SULPHIDE.—2s. 7d. to 2s. 1½d.

CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums.

CARBON BISULPHIDE.—£30 to £32 per ton, drums extra.

CARBON BLACK.—3½d. to 5d. per lb. LONDON: 4½d. to 5d.

CARBON TETRACHLORIDE.—SCOTLAND: £41 to £43 per ton, drums extra.

CHROMIUM OXIDE.—10½d. per lb., according to quantity d/d U.K.; green, 1s. 2d. per lb.

CHROMETAN.—Crystals, 3½d. per lb.; liquor, £19 10s. per ton d/d.

COPPERAS (GREEN).—SCOTLAND: £3 15s. per ton, f.o.r. or ex works.

CREAM OF TARTAR.—LONDON: £4 2s. 6d. per cwt. SCOTLAND: £4 2s. less 2½ per cent.

DINITROTOLUENE.—66/68° C., 9d. per lb.

DIPHENYLGUANIDINE.—2s. 2d. per lb.

FORMALDEHYDE.—LONDON: £26 per ton. SCOTLAND: 40%, £25 to £28 ex store.

IODINE.—Resublimed B.P., 6s. 3d. per lb. for quantities not less than 28 lb., increasing to 8s. 4d. per lb. for quantities less than 4 lb.

LAMPBLACK.—£45 to £48 per ton.

LEAD ACETATE.—LONDON: White, £34 10s. per ton; brown, £1 per ton less. SCOTLAND: White crystals, £33 to £35; brown, £1 per ton less. MANCHESTER: White, £34; brown, £31, 10s.

LEAD, NITRATE.—£28 per ton.

LEAD, RED.—SCOTLAND: £24 to £26 per ton less 2½%; d/d buyer's works.

LEAD, WHITE.—SCOTLAND: £39 per ton, carriage paid. LONDON: £37 10s.

LITHOPONE.—30%, £17 10s. to £18 per ton.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

METHYLATED SPIRIT.—61 O.P. Industrial, 1s. 6d. to 2s. 1d. per gal. Pyridinised industrial, 1s. 8d. to 2s. 3d. Mineralised, 2s. 7d. to 3s. 1d. 64 O.P. 1d. extra in all cases. Prices according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

NICKEL AMMONIUM SULPHATE.—£49 per ton d/d.

NICKEL SULPHATE.—£49 per ton d/d.

PHENOL.—8½d. to 9d. per lb. without engagement.

POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £37 10s.

POTASSIUM BICHROMATE.—Crystals and Granular, 5d. per lb. net d/d U.K. Discount according to quantity. Ground 5½d. LONDON: 5d. per lb. with usual discounts for contracts. SCOTLAND: 5d. d/d U.K. or c.i.f. Irish Ports. MANCHESTER: 5d.

POTASSIUM CHLORATE.—LONDON: £37 to £40 per ton. SCOTLAND: 99½/100%, powder, £37. MANCHESTER: £38.

POTASSIUM CHROMATE.—6½d. per lb. d/d U.K.

POTASSIUM IODIDE.—B.P., 5s. 2d. per lb. for quantities not less than 28 lb.

POTASSIUM NITRATE.—SCOTLAND: Refined granulated, £20 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 9½d. per lb. SCOTLAND: B.P. crystals, 9d. MANCHESTER: Commercial, 8½d.; B.P., 9½d.

POTASSIUM PRUSSIAN.—LONDON: 8½d. to 8½d. per lb. SCOTLAND: Yellow spot material, 8½d. ex store. MANCHESTER: Yellow, 9½d.

RUPRON (MINERAL RUBBER).—£15 10s. per ton.

SALAMONAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels.

SODA ASH.—55% spot, £5 15s. per ton f.o.r. in bags.

SODA, CAUSTIC.—Solid 76/77° spot, £13 17s. 6d. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks. Solid 76/77°, £14 10s. in drums; 70/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less. MANCHESTER: £13 5s. to £14 contracts.

SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

SODIUM ACETATE.—£22 per ton. LONDON: £23.

SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/d station in bags. SCOTLAND: Refined recrystallised £10 15s. ex quay or station. MANCHESTER: £10 10s.

SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount according to quantity. Anhydrous, 5d. per lb. LONDON: 4d. per lb. net for spot lots and 4d. per lb. with discounts for contract quantities. SCOTLAND: 4d. delivered buyer's premises with concession for contracts.

SODIUM BISULPHITE POWDER.—60/62%, £18 10s. per ton d/d 1-cwt. iron drums for home trade.

SODIUM CARBONATE (SODA CRYSTALS).—SCOTLAND: £5 to £5 5s. per ton ex quay or station. Powdered or pea quality 7s. 6d. per ton extra. Light Soda Ash £7 ex quay, min. 4-ton lots with reductions for contracts.

SODIUM CHLORATE.—£32 per ton.

SODIUM CHROMATE.—4d. per lb. d/d U.K.

SODIUM HYPOSULPHITE.—SCOTLAND: Large crystals English manufacture, £9 5s. per ton ex stations, min. 4-ton lots. Pea crystals, £14 10s. ex station, 4-ton lots. MANCHESTER: Commercial, £10 5s.; photographic, £15.

SODIUM META SILICATE.—£16 per ton, d/d U.K. in cwt. bags.

SODIUM IODIDE.—B.P., 6s. per lb. for quantities not less than 28 lb.

VERMILION.—Pale or deep, 3s. 11d. to 4s. 1d. per lb.

ZINC CHLORIDE.—SCOTLAND: British material, 98%, £18 10s. per ton f.o.b. U.K. ports.

ZINC SULPHATE.—LONDON: £12 per ton. SCOTLAND: £10 10s.

ZINC SULPHIDE.—11d. to 1s. per lb.

Coal Tar Products

ACID, CARBOLIC.—Crystals, 8½d. to 8½d. per lb.; crude, 60's, to 2s. 2½d. per gal. MANCHESTER: Crystals, 7d. to 7½d. per lb.; crude, 1s. 9d. per gal. SCOTLAND: 60's, 2s. 6d. to 2s. 7d.

ACID, CRESYLIC.—90/100%, 1s. 8d. to 2s. 3d. per gal.; pale 98%, 1s. 6d. to 1s. 7d.; according to specification. LONDON: 98/100%, 1s. 6d.; dark, 95/97%, 1s. 3d. SCOTLAND: Pale, 99/100%, 1s. 3d. to 1s. 4d.; dark, 97/99%, 1s. to 1s. 1d.; high boiling acid, 2s. 6d. to 3s.

BENZOL.—At works, crude, 9d. to 9½d. per gal.; standard motor, 1s. 3½d. to 1s. 4d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 7½d. to 1s. 8d. LONDON: Motor, 1s. 6½d. SCOTLAND: Motor, 1s. 6½d.

CREOSOTE.—B.S.I. Specification standard, 4d. to 4½d. per gal. f.o.r. Home, 3½d. d/d. LONDON: 3½d. f.o.r. North; 4d. London. MANCHESTER: 3½d. to 4½d. SCOTLAND: Specification oils, 4d.; washed oil, 4½d. to 4½d.; light, 4½d.; heavy, 4½d. to 4½d.

NAPHTHA.—Solvent, 90/160%, 1s. 6d. to 1s. 7d. per gal.; 95/160%, 1s. 7d. to 1s. 8d.; 99%, 11d. to 1s. 1d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. SCOTLAND: 90/160%, 1s. 3d. to 1s. 3½d.; 90/190%, 11d. to 1s. 2d.

NAPHTHALENE.—Purified crystals, £10 per ton in bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s.; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 70s. to 75s.

PITCH.—Medium soft, 57s. 6d. per ton, in bulk, at makers' works. LONDON: £3 per ton f.o.b. East Coast port for next season's delivery.

PYRIDINE.—90/140, 7s. 6d. to 9s. per gal.; 90/180, 2s. 3d. per gal.

TOLUOL.—90%, 2s. per gal.; pure, 2s. 3d.

XYLOL.—Commercial, 2s. per gal.; pure, 2s. 3d.

Intermediates and Dyes

ACID, BENZOIC, 1914 B.P. (ex Toluol).—1s. 9½d. per lb.

ACID, GAMMA.—Spot, 4s. per lb. 100% d/d buyer's works.

ACID, H.—Spot, 2s. 4½d. per lb. 100% d/d buyer's works.

ACID NAPHTHIONIC.—1s. 8d. per lb.

ACID, NEVILLE AND WINTHER.—Spot, 3s. per lb. 100%.

ACID, SULPHANILIC.—Spot, 8d. per lb. 100% d/d buyer's works.

ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.

BENZALDEHYDE.—Spot, 1s. 8d. per lb., packages extra.

BENZIDINE BASE.—Spot, 2s. 5d. per lb., 100% d/d buyer's works.

BENZIDINE HCL.—2s. 5d. per lb.

p-CRESOL 34.5° C.—2s. per lb. in ton lots.

m-CRESOL 98/100%.—2s. 3d. per lb. in ton lots.

DICHLORANILINE.—1s. 11½d. to 2s. 3d. per lb.

DIMETHYLANILINE.—Spot, 1s. 6d. per lb., package extra.

DINITROBENZENE.—8d. per lb.

DINITROTOLUENE.—48/50° C., 9d. per lb.; 66/68° C., 01½d.

DINITROCHLOROBENZENE, SOLID.—£72 per ton.

DIPHENYLAMINE.—Spot, 2s. per lb., d/d buyer's works.

α-NAPHTHOL.—Spot, 2s. 4d. per lb., d/d buyer's works.

β-NAPHTHOL.—Spot, £78 15s. per ton in paper bags.

α-NAPHTHYLAMINE.—Spot, 11½d. per lb., d/d buyer's works.

β-NAPHTHYLAMINE.—Spot, 2s. 9d. per lb., d/d buyer's works.

o-NITRANILINE.—3ss. 11d. per lb.

m-NITRANILINE.—Spot, 2s. 7d. per lb., d/d buyer's works.

p-NITRANILINE.—Spot, 1s. 8d. per lb., d/d buyer's works.

NITROBENZENE.—Spot, 4½d. to 5d. per lb.; 5-cwt. lots, drums extra.

NITRONAPHTHALENE.—9d. per lb.; P.G., 1s. 0½d. per lb.

SODIUM NAPHTHIONATE.—Spot, 1s. 9d. per lb.

o-TOLUIDINE.—9½d. to 11d. per lb.

p-TOLUIDINE.—1s. 11d. per lb.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—£6 14s. 6d., September £6 16s., October £6 17s. 6d., November £6 19s., December £7, January, 1935, £7 2s., February £7 3s. 6d., March/June £7 5s. for neutral quality basis 20.6 per cent. nitrogen delivered in 6-ton lots to farmer's nearest station.

CYANAMIDE.—September £6 16s. 3d., October £6 17s. 6d., November £6 18s. 9d., December £7, January, 1935, £7 1s. 3d., February £8 2s. 6d., March £7 3s. 9d., April/June £7 5s., delivered in 4-ton lots to farmer's station.

NITRATE OF SODA.—£7 12s. 6d. per ton for delivery up to June, 1935, in 6-ton lots carriage paid to farmer's nearest station for material basis 15.5 per cent. or 16 per cent. nitrogen.

NITRO-CHALK.—£7 5s. per ton for delivery up to June, 1935, in 6-ton lots carriage paid to farmer's nearest station for material basis 15.5 per cent. nitrogen.

CONCENTRATED COMPLETE FERTILISERS.—£10 5s. to £10 17s. 6d. per ton according to percentage of constituents.

NITROGEN PHOSPHATE FERTILISERS.—£10 5s. to £13 15s. per ton according to percentage of constituents.

Latest Oil Prices

LONDON, Sept. 5.—LINSEED OIL was steady. Spot, £21 5s. (small quantities 30s. extra); Sept.-Dec., £20; Jan.-April, £20 2s. 6d.; May-Aug., £20 7s. 6d., naked. SOYA BEAN OIL was quiet. Oriental (bulk), Sept.-Oct. shipment, £14 10s. per ton. RAPE OIL was slow. Crude, extracted, £27; technical refined £28 10s., naked, ex wharf. COTTON OIL was quiet. Egyptian crude, £14; refined common edible, £17 5s.; and deodorised, £18 15s., naked, ex mill (small lots 30s. extra). TURPENTINE was easier. American, spot, 41s. 6d. per cwt.

HULL.—LINSEED OIL, spot, quoted £20 10s. per ton; Sept.-Dec. and Jan.-April, £20 2s. 6d., naked. COTTON OIL, Egyptian, crude, spot, £14 10s.; edible, refined, spot, £16 10s.; technical, spot, £16 10s.; deodorised, £18 10s., naked. PALM KERNEL OIL, crude, f.m.q., spot, £14 10s. naked. GROUNDNUT OIL, extracted, spot, £20 10s.; deodorised, £24 10s. RAPE OIL, extracted, spot, £26; refined, £27 10s.. SOYA OIL, extracted, spot, £17; deodorised, £20 per ton. COD OIL (industrial), 25s. per cwt. CASTOR OIL, pharmaceutical, 36s.; first, 31s.; second, 28s. per cwt. TURPENTINE, American, spot, 43s. 6d. per cwt.

Inventions in the Chemical Industry

Patent Specifications and Applications

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Complete Specifications Open to Public Inspection

- FEMALE SEXUAL HORMONE, manufacture.—F. Hoffmann-La Roche and Co., A.-G. Feb. 24, 1933. 1164/34.
- COLOURING ORGANIC SOLVENTS, lacquers, fats, oils, resins, waxes, and products obtained therefrom.—I. G. Farbenindustrie. Feb. 25, 1933. 1200/34.
- DRY ADHESIVES.—Henkel et Cie, Ges. Feb. 24, 1933. 1482/34.
- ADHESIVE COMPOSITIONS.—E. I. du Pont de Nemours and Co. Feb. 23, 1933. 3714/34.
- CONCENTRATED NITRIC ACID, and apparatus therefor, production. E. I. du Pont de Nemours and Co. Feb. 24, 1933. 3715/34.
- CHROMIFEROUS AZO DYESTUFFS, manufacture.—Soc. of Chemical Industry in Basle. Feb. 21, 1933. 4756/34.
- CHROMIFEROUS AZO DYESTUFFS, manufacture.—Soc. of Chemical Industry in Basle. Feb. 22, 1933. 4759/34.
- TITANIUM COMPOUNDS, production.—Titan Co., Inc. Feb. 24, 1933. 5241/34.
- SEPARATION OF ARSENIC and antimony from complex sulphur compounds of copper.—H. Cmyral. Feb. 21, 1933. 5771/34.
- CHLORHYDRINS, manufacture.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. Feb. 27, 1933. 5780/34.
- SULPHUR DYESTUFFS, manufacture.—Soc. of Chemical Industry in Basle. Feb. 25, 1933. 5980/34.
- TITANIUM PIGMENTS.—Titanges. Feb. 23, 1933. 6035/34.
- DYESTUFFS of the pyrene series, manufacture.—I. G. Farbenindustrie. Feb. 25, 1933. 6195/34.
- AMINOPYRENESULPHONIC ACIDS, manufacture.—I. G. Farbenindustrie. Feb. 25, 1933. 6196/34.
- PRINTING WITH DYESTUFFS.—Durand and Huguenin A.-G. Feb. 27, 1933. 6347/34.
- DYESTUFFS OF THE DIBENZANTHRONE SERIES and their manufacture.—E. I. du Pont de Nemours and Co. Feb. 27, 1933. 6373/34.
- DYEING ACETATE ARTIFICIAL SILK.—Soc. of Chemical Industry in Basle. Sept. 20, 1932. 24098/34.
- SUBSTANTIVE DYESTUFFS, manufacture.—Deutsche Hydrierwerke A.-G. Jan. 29, 1932. 24347/34.

Specifications Accepted with Dates of Application

- HYDROXYALKYL-HYDROXY DERIVATIVES of 2-phenylquinoline-4-carboxylic acid, manufacture.—Schering-Kahlbaum A.-G. Feb. 22, 1933. 415,088.
- BUTYL ALCOHOL by fermentation, production.—Commercial Solvents Corporation. Jan. 3, 1933. 415,312.
- STABILISING CELLULOSE ESTERS, process.—A. H. Stevens (Dr. E. Berl). Jan. 30, 1934. 415,329.
- LIGHT-SENSITIVE LAYERS by means of diazo compounds, production.—Kalle and Co. A.-G. Feb. 18, 1933. 415,081.
- BORON CARBIDE and method of making the same.—W. W. Triggs (Norton Co.). Nov. 18, 1932. 415,392.
- SEPARATING DI-ACETYLENE from gases containing acetylene, process.—Ruhrechemie A.-G. Feb. 5, 1932. 415,377.
- HYDRATION OF OLEFINS.—Distillers Co., Ltd., W. P. Joshua, H. M. Stanley and J. B. Dymock. Jan. 24, 1933. 415,426.
- HYDRATION OF OLEFINS.—Distillers Co., Ltd., W. P. Joshua, H. M. Stanley and J. B. Dymock. Jan. 24, 1933. 415,427.
- DERIVATIVES OF CELLULOSE, manufacture.—H. Dreyfus. Feb. 16, 1933. 415,382.
- CARBOHYDRATE COMPOUNDS, manufacture.—H. Dreyfus. Feb. 16, 1933. 415,383.
- CORROSION-RESISTING COVERINGS for pipes and other articles.—Chemieprodukte Ges. July 15, 1932. 415,384.
- COLLOIDAL SULPHUR, manufacture.—E. I. du Pont de Nemours and Co. Feb. 23, 1932. 415,407.
- CELLULOSE NITRATES, treatment.—Du Pont Viscoloid Co. and R. K. Eskew. Feb. 22, 1933. 415,408.
- RUBBER having age-resisting properties, production.—E. I. du Pont de Nemours and Co. Feb. 26, 1932. 415,436.
- RUBBER SOLUTIONS and of rubber conversion products therefrom, process for the manufacture.—I. G. Farbenindustrie. Feb. 25, 1932. 415,438.
- ALKALI METAL HYDROXIDE SOLUTIONS, process for the manufacture.—I. G. Farbenindustrie. Feb. 25, 1932. 415,466.
- OXALIC ACID and esters thereof, manufacture.—E. I. du Pont de Nemours and Co. Feb. 27, 1932. 415,472.
- LUBRICATING OILS, manufacture and production.—J. Y. Johnson (I. G. Farbenindustrie). April 18, 1933. 415,526.
- HIGH MOLECULAR SULPHONES, manufacture.—W. J. Tennant (Henkel et Cie Ges.). April 21, 1933. 415,526.
- HYDROGEN CHLORIDE, manufacture and production.—H. Stoltzenberg (trading as Chemische Fabrik Dr. H. Stoltzenberg). June 22, 1932. 415,551.
- CONDENSATION PRODUCTS capable of being moulded, and of moulded articles therefrom, manufacture.—Soc. of Chemical Industry in Basle. July 5, 1932. 415,555.
- SYNTHETIC LACQUERS, preparation.—Soc. des Laques et Matières Plastiques. Aug. 23, 1932. 415,582.
- TITANIUM PIGMENTS, purification.—Titan Co., Inc. Oct. 29, 1932. 415,602.
- STARCH PREPARATIONS for producing adhesives, manufacture.—Henkel et Cie, Ges. Dec. 14, 1932. 415,611.
- INDIGOID DYESTUFFS, manufacture.—Soc. of Chemical Industry in Basle. Dec. 27, 1932. 415,632.
- HYDROGEN PEROXIDE, process and apparatus for the production. Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler. Aug. 14, 1933. 415,658.
- LIQUID AND SOLID CARBON DIOXIDE, apparatus for the production.—Maiuri Refrigeration Patents, Ltd., and G. Maiuri. Feb. 20, 1934. 415,659.
- ALKALI METAL NITRATE from calcium nitrate and alkali metal chloride, manufacture and production.—I. G. Farbenindustrie. March 17, 1933. 415,660.

Applications for Patents

August 23 to 29 (inclusive).

- EXPLOSIVES, manufacture.—C. Belani and Bergite Co., Ltd. 24797, 24798.
- ACID CALCIUM CITRATE, manufacture.—A. H. Bennett. 24414.
- EMULSIFYING, ETC., AGENTS.—W. E. Billingham. 24508.
- POTASSIUM SULPHATE, making.—Borax Consolidated, Ltd., and G. A. Connell. 24891.
- DYESTUFFS, manufacture.—A. Carpmal (I. G. Farbenindustrie). 24485.
- POLYMERISATION PRODUCTS OF OLEFINS, manufacture.—A. Carpmal (I. G. Farbenindustrie). 24351.
- IMPREGNATING BATHS, preparation.—A. Carpmal (I. G. Farbenindustrie). 24862.
- ANTHRAQUINONE DYESTUFFS.—A. Carpmal (I. G. Farbenindustrie). 24863, 24864.
- MONOAZO DYESTUFFS, manufacture.—A. Carpmal (I. G. Farbenindustrie). 24912.
- AZO DYESTUFFS, manufacture.—A. Carpmal (I. G. Farbenindustrie). 24913.
- DYEING MASSES OF MATERIALS.—A. Carpmal (I. G. Farbenindustrie). 24914.
- OIL GAS, manufacture.—H. E. Coley. 24331.
- DISTILLATION FOR PRODUCTION OF VOLATILE METALS, process.—H. E. Coley. 24624.
- LUMINOUS SULPHIDES.—L. J. Derham. 24313.
- SUBSTANTIVE DYESTUFFS, manufacture.—Deutsche Hydrierwerke. (Jan. 23, '33.) (Germany, Jan. 29, '32.) 24347.
- BAKUM SULPHATE, production.—C. G. R. Drotschmann. 24801.
- PIGMENTED COATING COMPOSITION.—E. I. du Pont de Nemours and Co. (United States, Aug. 23, '33.) 24371.
- VULCANISATION OF RUBBER.—E. I. du Pont de Nemours and Co. (United States, Aug. 23, '33.) 24372.
- CELLULOSE PIGMENTS, production.—E. I. du Pont de Nemours and Co. (United States, Aug. 24, '33.) 24446.
- VULCANISATION OF RUBBER.—E. I. du Pont de Nemours and Co. 24800.
- CONDENSATION PRODUCTS, manufacture.—W. W. Groves (I. G. Farbenindustrie). 24646.
- AZO DYESTUFFS, manufacture.—I. G. Farbenindustrie. (Germany, Aug. 24, '33.) 24486.
- HALOGENAMINE ALKYL SULPHURIC ESTERS, etc., manufacture.—I. G. Farbenindustrie. (Germany, Aug. 29, '33.) 24641.
- CARBONISATION, etc., of solid materials.—Illingworth Carbonisation Co., Ltd., and S. R. Illingworth. (Nov. 30, '33.) 24680.
- LIQUID HYDROCARBONS, etc., production.—International Hydrogenation Patents Co., Ltd. (Germany, Sept. 19, '33.) 24716.
- SPLITTING HYDROCARBON MIXTURES.—J. Y. Johnson (I. G. Farbenindustrie). 24869.
- AZO DYESTUFFS, manufacture.—J. Y. Johnson (I. G. Farbenindustrie). 24870.
- VAT DYESTUFFS, manufacture.—J. Y. Johnson (I. G. Farbenindustrie). 24871.
- SOLUBLE SALTS, manufacture.—May and Baker, Ltd. 24333.
- WATER-RESISTANT CALCIUM SULPHITE, production.—Mining and Industrial Works, formerly J. D. Starck. (Czecho-Slovakia, Oct. 24, '33.) 24926. (Czecho-Slovakia, May 9.) 24927.
- WATER, purification.—Mining and Industrial Works, formerly J. D. Starck. (Czecho-Slovakia, Oct. 24, '33.) 24928.
- WATER-RESISTANT BODIES OF CALCIUM OXIDE, etc.—Mining and Industrial Works, formerly J. D. Starck. March 12. 24929.

From Week to Week

DISTILLED WATER AND ACID CARRIERS, LTD., Cross Keys House, 56 Moorgate, E.C.2, have changed their name to Starley Springs, Ltd.

W. G. WILSON & Co., who are distributors of chemicals and allied products for all industries, have just issued a list of products for which inquiries are specially invited.

THE DIRECTORS OF ACETEX SAFETY GLASS, LTD., will submit proposals for voluntary liquidation at the annual meeting on September 26. The accounts for the year to June 30 last disclose a net loss of £4,484, and a total deficit of £59,585. The issued capital is £210,000.

THE FIRST MEETING of the 1934-35 session of the Ceramic Society, Pottery Section, will be held on September 10, at 7.30 p.m., at the North Staffordshire Technical College, Stoke-on-Trent. Mr. E. W. T. Mayer will give a paper entitled "A Chat on Colours."

MR. R. P. WHITELOW, C.B.E., of Johannesburg, who died in Edinburgh while on a visit to this country, was well known as a mining engineer. During the war he was engaged in valuable research work, and invented a new type of mustard gas. Mr. Whitelaw was a native of Stirling and his wife was a Stirling woman.

THE RECENT IMPROVEMENT IN BUSINESS in iron and steel has been maintained during the past week, and not only has there been a larger volume of inquiry, but trading has been more active than for several weeks past. In the pig-iron market a fair amount of new business has been placed lately, and although most of the transactions have been limited to small parcels, the turnover has been satisfactory.

THE ALEMIC CHEMICAL WORKS CO., of Baroda, India, are undertaking the manufacture of dry ice in large quantities and are erecting machinery for the same. There is extensive scope for the use of dry ice in India, as the temperatures are hot throughout the year and many articles of food become useless for human consumption on account of deterioration. It will also be used in the aerated water trade.

THE INSTITUTE OF METALS held its annual autumn meeting at the Manchester Municipal College of Technology, September 4 to 7. The proceedings opened with a lecture by Dr. J. L. Haughton on the work of the late Dr. W. Rosenhain, an original member of the Institute at its foundation in 1908, a former president, and for ten years chairman of its Publications Committee. Manchester has on two previous occasions entertained the Institute.

TRADE PROMOTION TRUST, LTD., has issued a new brochure on "The Use of Credit," setting forth the advantages of the hire purchase and deferred payment systems in modern retail businesses. It points out that two problems may arise in the supplier's mind, (1) how are such transactions to be financed and (2) how is such business done. To both these questions the Trade Promotion Trust service provides the answer, designed on well thought out lines based on a wide experience, with the necessary elasticity to be adjustable to the differing needs of various classes of suppliers. Full particulars of the service may be obtained from Bouverie House, Fleet Street, E.C.4.

CONTROL OF IMPORTS AND DISTRIBUTION in Germany has been extended to asbestos. The control is to be exercised by the Rubber Control Board. During the first seven months of this year, Germany's imports of asbestos, at 11,491 metric tons, were nearly double those during the corresponding period of 1933, when the imports amounted to 6,200 metric tons, compared with only 3,781 tons in the first seven months of 1932. The increased arrivals this year are mainly due to larger purchases in the British Empire, the imports from Canada advancing to 4,692 metric tons, compared with 2,451 tons a year ago, and those from British South Africa to 2,298 metric tons, from 1,746 tons. Apart from Canada, the leading importer into Germany is Russia, with a total of 3,746 metric tons, compared with 1,363 metric tons during the first seven months of 1933.

FOR ACHIEVEMENTS IN AGRICULTURAL CHEMISTRY, Dr. Jacob Goodale Lipman, director of the New Jersey Agricultural Experiment Station, has been awarded the Chandler Medal of Columbia University for 1934. Dr. Lipman's work on the determination of the nature of the chemical action produced by bacteria in making both organic and inorganic components of soils available for plant food has been of great importance to agriculture all over the world. He introduced certain conceptions in the field of soil bacteriological chemistry that have been shown to be fundamental in the practical handling of soils. His researches on the utilisation of nitrogen by plants, especially upon the soil reactions that influence the availability of nitrogen to plants, are outstanding contributions. His work in general on soil reactions that influence the availability of chemical elements essential to plant growth has led his researches into the study of the soil chemistry of sulphur, phosphorus, selenium, etc.

EXTENSIVE TESTS at the University of California have proved Inconel to be the most satisfactory metal for use in organic combustion analyses.

MR. ISAAC MCINTYRE BROWN, of 6 Wellington Place, Ecclehill, Bradford, a director of the Bradford Dyers' Association, and of Whitehead and Miller, Ltd., printers and bookbinders, Leeds, left £17,267 (net personalty £16,175).

THE GLASGOW GAS COMMITTEE state that 5,000 gallons of chemical wash hitherto run off as waste had been converted into benzol fluid which was sold at 2s. 3d. a gallon. The conversion was brought about by the installation of plant at Provan Chemical Works.

A CENTRIFUGAL PUMP MADE OF NIDRESIST (nickel-chromium-copper cast iron), operating on caustic solutions in an oil refinery, has given more than 18 months' satisfactory service. Ordinary cast iron, previously used, required replacement about every three months.

NEGOTIATIONS ARE PROCEEDING between the Irish Free State Ministry of Industry and Commerce and the Dunlop Rubber Co. for the establishment of a tyre factory in the Free State to supply the needs of the Free State market. A few weeks ago it became known that Dunlops had acquired a part of the Ford estate in Cork city.

A NUMBER OF QUESTIONS were recently asked in the Indian Legislative Assembly in regard to the proposal to grant concessions to Imperial Chemicals, Ltd. (India) to start chemical works in any part of India and to utilise the mineral wastes. On behalf of the Government it was replied that the proposal was under consideration, but details of the scheme could not be disclosed.

LIVES WERE ENDANGERED BY FUMES when a chemical factory belonging to Pinnington, Dawson and Wood, Ltd., of Radcliffe, Lancashire, caught fire on August 22. There were only a few employees in the chemical works at the time of the outbreak, and they had ample time to leave. The works are situated on the banks of the river Irwell, and now and again great sections of wall and blazing debris crashed into the water.

MR. RAYMOND R. BUTLER, who has been principal of the Technical College, Aston, for the past three years, has taken up his new appointment as principal of the Liverpool Central Technical School in succession to Mr. J. Scholes Hague, who is retiring after holding that position since 1914. Mr. Butler is a native of London, where he was born in 1889. In 1920 he became lecturer in physical and applied chemistry at the Northern Polytechnic, London, and five years later was appointed head of the Department of Chemistry at Plymouth Technical College, where he remained until 1931, when he became the principal of Aston Technical College.

CONSIDERABLE ALARM WAS CAUSED in the Garnad district of Glasgow in the early hours of August 31, by an outbreak of fire which occurred in a distilling plant at Provan Chemical Works, belonging to Glasgow Corporation. The outbreak was observed by a workman, who saw flames in one of the distilling tanks which contained cresylic acid. The flames in the distilling tank spread with alarming rapidity to a number of drums of benzol lying near by and there was a series of explosions. Although hampered by fumes and clouds of smoke, the firemen succeeded in reaching the seat of the outbreak and prevented the flames from spreading to other parts of the works. The outbreak was completely extinguished after about two hours and involved only a comparatively small area of the works. It is understood that the fire was due to a leakage in the bottom of the tank whereby the acid was allowed to escape and to come into contact with a boiler underneath, thus causing it to become ignited. The loss caused by the outbreak is estimated at £1,000.

ERECTED AT A COST OF NEARLY £50,000, the new extension to the factory of Scottish Dyes at Grangemouth was opened on September 1, before a large gathering of the staff, employees, and their wives. The new addition to the works comprises a standardising building fitted with the most modern plant, with the primary object of improving the qualities of the dyes manufactured. Attention has also been paid to the interests of the workers, who will be enabled to perform their duties under the most hygienic conditions. Dr. W. G. Hiscock, the works manager, who presided at the opening ceremony, said the dye industry in Grangemouth had grown up from very modest beginnings, but gradually they had been able to improve their conditions and plant. The expense of the extension to the factory would be fully justified by the results which would be achieved. They were not introducing any new stages in manufacture. They were simply regrouping and modernising their plant. They were certainly introducing refinements in technique which would give them a quality as good as anything in the world. Mr. R. S. Horsfall, director of the Dyestuffs Group, Manchester, who performed the opening ceremony, said the plant they had in the new extension was absolutely necessary in order to present the products made at Grangemouth to the consumer in the most desirable market form.

SHOULD EXPERIMENTS PROVE SUCCESSFUL in the village of Bellochinty, on the west coast of Kintyre, a new industry will probably be commenced there. Cefoil, Ltd., Maidenhead, Berks, who have already a plant on the Thames, plan to erect an experimental plant at Bellochinty for the purpose of producing cellophane from seaweed. Estimates are being made out for the construction of the works, which will consist mainly of a group of filters and a building in which the seaweed will be chemically treated. It is understood that the company intend to utilise as much local labour as possible. During the experimental stages at least ten tons of seaweed will be required daily. If the experiments are successful it is probable that that figure will be quintupled. The collection of such a large quantity of seaweed will provide work for local labour.

AMONG THE NEW FACTORIES now being erected at Welwyn Garden City is one for Ferramic Industries, Ltd., who are making a new type of raw enamel for enamelling hardware of all descriptions with special resisting finishes. This is a new invention of considerable industrial importance and the first unit of the factory is so designed that it can be readily extended to a much larger size. Another new factory now in course of erection at Welwyn Garden City is for the Barnet Comb Co., who will make 10,000,000 combs per annum for the British market. Five existing factories are in course of extension including the Film Studio, Beiersdorf, Ltd. (makers of medical plasters, skin creams, etc.), A. Buchanan and Sons (toffee manufacturers), Mouldrite, Ltd. (moulding powders), Welwyn Foundry, Ltd. (moulding shops for rain water goods).

Books Received

Official Publications

Bulletin of the Imperial Institute. Vol. XXXII. No. 2. 1934. London: John Murray. Pp. 342. 3s. 6d.

The Lancashire Coalfield. Analysis of Commercial Grades of Coal—Part I. Department of Scientific and Industrial Research. Fuel Research. London: H.M. Stationery Office. Pp. 90. 1s. 6d.

Research Reprints

Combating Noise. The Rubber Growers' Association. Reprinted from the Association's Bulletin.

Researches in the Phenanthridine Series. Part III. Meso-substituted Derivatives. Leslie P. Walls. Reprinted from the Journal of the Chemical Society, January, 1934.

Homologues of Phenol. Gilbert T. Morgan and Alfred E. J. Pettet. **Perylene and Derivatives.** Gilbert T. Morgan and James G. Mitchell. Reprinted from the Journal of the Chemical Society, April, 1934.

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Anthracenoid Hydrocarbons of Low Temperature Tar. Gilbert T. Morgan and E. A. Coulson. **Separation of 1- and 2-Methylnaphthalenes.** Gilbert T. Morgan and E. A. Coulson. **Oil-Soluble Phenolic Resins.** E. Leighton Holmes. Reprinted from the Journal of the Society of Chemical Industry, March 16, 1934.

Company News

United Glass Bottle Manufacturers.—An ordinary interim of 2½ per cent. is payable on September 18.

Southall Bros. and Barclay.—An ordinary interim of 10 per cent., tax free, is announced, payable on October 2.

Broken Hill South, Ltd.—The net profit for the year to June 30 last amounted to £220,214, of which mining operations contributed £139,543, and investments £80,671.

Amalgamated Zinc (de Bavay's).—A dividend has been declared at the rate of 5 per cent. per annum for the six months ended June 30, payable at the registered office of the company on October 5.

New Chemical Trade Marks

Compiled from official sources by Gee and Co., patent and trade mark agents, Staple House, 51 and 52 Chancery Lane, London, W.C.2.

Opposition to the registration of the following trade mark can be lodged up to October 5, 1934.

Manox. 552,596. Class 2. Chemical substances used for agricultural and horticultural purposes. The Manchester Oxide Co., Ltd., Canal Street, Miles Platting, Manchester. July 13, 1934.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

South Africa.—H.M. Senior Trade Commissioner in South Africa reports that the South African Railways and Harbours Administration is calling for tenders (Tender No. 375), to be presented in South Africa by October 22, 1934, for the supply of 8,700 imperial gallons of machine oil. (Ref. B.Y. 7869.)

Portugal.—A commission agent established at Oporto wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of drugs and chemical products. (Ref. No. 223.)

APPOINTMENTS VACANT

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